NAVAIR 50-1C-528

U. S. NAVY MARINE CLIMATIC ATLAS OF THE WORLD

VOLUME I

NORTH ATLANTIC OCEAN

(REVISED 1974)

PUBLISHED BY DIRECTION OF THE COMMANDER,
NAVAL WEATHER SERVICE COMMAND

NAVAIR 50-1C-528

U. S. NAVY
MARINE CLIMATIC ATLAS OF THE WORLD
VOLUME I
NORTH ATLANTIC OCEAN

THIS REPLACES NAVAER 50-1C-528 DATED 1955

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BY DIRECTION OF THE COMMANDER, NAVAL WEATHER SERVICE COMMAND

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DECEMBER 1974

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TAB 76-10

FOREWORD

A joint feasibility study for producing a combined climatological oceanographic atlas of the water areas of the world was undertaken by the Naval Weather Service Command and the Naval Oceanographic Office in 1969. The results of this feasibility study revealed a twofold increase in surface marine observations over the North Atlantic basin since Volume I of the U.S. NAVY MARINE CLIMATIC ATLAS OF THE WORLD was published. The additional data plus recommendations for revised content and format, provided by various Naval Weather Service fleet units and field activities, warranted the updating of the entire series of marine climatic charts of the world.

The Naval Weather Service Detachment, Asheville was tasked to produce a technical model of the atlas providing a sample of each type of page presentation proposed with supporting documentation. The atlas mock-up was approved by Headquarters, Naval Weather Service Command in 1971 as the model for this atlas and future volumes of this series.

ACKNOWLEDGMENT

This volume was prepared by direction of the Commander, Naval Weather Service Command, at the National Climatic Center.

Specific acknowledgment for the meterological part is made to Messrs. R. G. Quayle, D. C. Fulbright and J. D. Elms for their assistance in the editorial evaluation and analyses of the data; Messers. R. H. Courtney, R. G. Baldwin and Mrs. D. T. Hawkins for drafting.

The oceanographic part was prepared by the U. S. Naval Oceanographic Office, whose contribution is acknowledged with thanks. Specific acknowledgement is made to William Boisvert, George Boyd, Robert Peterson, and Cyrus Rhode, Jr., for their analytic contributions, to William Erb for technical coordination, and to Gordon R. Cox, Harry McCathran, Patricia Stagg, Bonnie Martino, and Walter Yanchulis for illustrating.

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PART I - METEOROLOGY

INTRODUCTION

The eight volume series of the U. S. Navy Marine Climatic Atlas of the World has had wide acceptance as an authoritative reference for large scale operational planning and applied research. This volume, based on nearly 20 years of additional data, is an update of Volume I (U.S. Navy Marine Climatic Atlas of the World, 1955) and is designed to fulfill the same requirements. This volume is not, however, a one for one revision. Some of the data presentations have been changed and wave statistics have been added. There are no upper air charts presented since in recent years several comprehensive volumes of upper air data have been published separately: (*Upper Wind Statistics Charts of the Northern Hemisphere*, Volumes I and II, NAVAER 50-1C-535, 1959; *Components of the 1000 MB Winds of the Northern Hemisphere*, NAVAIR 50-1C-51, 1966; *Selected Level Heights, Temperatures and Dew Points for the Northern Hemisphere*, including Monthly Mean Wind Speed and Direction, NAVAIR 50-1C-52, 1970; *Selected Meridional Cross Sections of Heights, Temperatures and Dew Points of the Northern Hemisphere*, NAVAIR 50-1C-59, 1971).

The descriptive explanations which follow give details concerning the quality control and processing of the observations, the development of the charts and graphs and a few possible applications of the various charts. Also discussed are limitations imposed by the quality of the data and the methods adapted to overcome them, to the extent possible.

This Atlas is the result of a concerted and extensive effort by many people (aided by modern data processing equipment) to present a detailed and useful ocean climatology.

THE GENERAL PLAN OF THE CHARTS

The "point statistics" of land climatology are made possible by the maintenance of weather records at fixed locations for long periods. However desirable, statistics for most ocean areas are not available to the same extent. In the past three decades, however, the Ocean Weather Station (OWS) networks maintained through the cooperation of several maritime nations have been a real step toward fixed point locations. Unfortunately, as this volume is being published, these stations are being phased out.

Beyond the coverage afforded by the 10 Ocean Weather Stations in the North Atlantic, there remain vast areas for which transient ships' logs of surface weather observations are the only source of detailed knowledge of ocean climate.

Where the number of observations is sufficient, it is possible to select areas small enough to permit an approximation to the "point statistics" of land stations. There are 50 such representative areas used in this atlas. The locations are outlined on the base chart and numbered. In a departure from the method used in the previous atlas, the graphs and tables computed for these areas have been placed on the facing page rather than on the base chart. This was made necessary by the smaller size of the published charts and also permitted a larger number of areas and more isopleth analyses.

THE OBSERVATIONS AND THEIR PROCESSING

Variations in definitions, codes and units of measurement used by maritime nations for recording and punching marine observations have resulted in 18 different forms (or "decks") of punched cards available for use at the National Climatic Center. During the past decade, most of these card decks have been placed into one tape deck in a common format. A team of meteorologists converted the units and codes in the separate decks to the common format. For a more detailed explanation of the conversion procedures, the reader is referred to the Tape Data Family-11 (TDF-11) Reference Manual (National Climatic Center, 1968). This tape deck was used in the computations in this volume. Funding for the development of TDF-11 was provided primarily by the Naval Weather Service Command with supplemental support from the Environmental Science Services Administration (now NOAA) and the Department of Defense.

The data were subjected to complex quality control procedures before processing. First, duplicate observations (identical observations which entered the data base from different sources) were eliminated. The remaining observations were then checked for internal consistency. Elements which failed to meet the internal consistency checks were either corrected or eliminated. The data were subjected to an extreme value check in which the highest and lowest values of appropriate elements were listed and checked. The duplicate elimination, internal consistency and extreme value programs are available at the National Climatic Center (National Climatic Center, 1974). These quality controlled data have been retained in a separate tape file designated as the U. S. Navy Marine Atlas Work Tapes.

Regardless of the amount of quality control to which marine observations are subjected there are inherent problems caused by the difficulty in taking observations of some meteorological elements from an unstable platform, different levels of observer experience, recording errors, variations in observing and coding practices, punching errors, and the scarcity of observations over vast areas. Another major problem is that which has been designated "fair weather bias." In recent years (the period when about half of the observations used in this volume were taken) radio communication and ship routing has been such that ships may be more frequently diverted from areas of bad weather. The apparent result has been to bias the observations which are recorded toward relatively good weather. A study by Quayle (1974) has shown this apparent bias to be quite marked for some elements when transient ship observations are compared to those from the Ocean Weather Stations. In areas removed from the OWS locations, there are different factors to consider with reference to the suspected "fair weather bias." In restricted areas such as inland seas, approaches to passes, straits and harbors, ship's masters do not have as much freedom of choice of routing and observations taken are thus less likely to be "biased." Also, it has been noted that because of less frequent occurrence of "bad" weather in lower latitudes, the "bias" toward good weather becomes less. In the tropics, there are no OWS data to be compared, but because of the relative homogeneity it is felt that transient ship data are reasonably representative.

The observations from the OWS's offer several obvious advantages to marine climatology:

1. A continuous or nearly continuous on-station record is obtained. Approximately 25 years of records are available.

2. The ships are especially equipped for weather observing.

3. Trained observers record the weather; therefore, conformity with established observing practices may be expected.

4. Observations are made at least every 3 hours, thereby permitting tabulation of duration frequencies.

5. All observable elements are regularly observed.

6. A high degree of instrumental accuracy may be expected.

7. Most positions are away from heavily traveled shipping lanes.

8. Ships are not usually under way under full power when weather observations are made.

With regard to transient ship observations, complete observations are steadily becoming more common. Ships' weather logs of past decades, incomplete by today's standards, show wind direction and speed to be the elements almost invariably recorded. From a survey of the data available for this atlas, the percentage of observations containing other basic weather elements is as follows:

Element	*Percent*
Air Temperature	97
Sea Temperature	90
Total Cloud Amount*	78
Visibility*	76
Sea Level Pressure	71
Present Weather*	64
Low Cloud Amount*	50
Wet Bulb Temperature	46
Waves*	42

*Because of incompatible observing or coding procedures, many of the observations of total cloud amount, visibility, present weather, low cloud amount, and wave data have been eliminated from the computations. This significantly reduced the percentages of these elements in the above table. The rejection of these data, unfortunately, does not eliminate the problems, but does alleviate them.

The elements in which the confidence level is not high are listed below:

PRECIPITATION – Of all of the elements recorded in historical marine observations, precipitation is one of those most subject to error in interpretation. This derives from a number of causes such as coding practices, observers' preference for certain present weather codes and fair weather bias.

SEA SURFACE TEMPERATURE – This element is recorded with a fairly high frequency in marine observations. The various methods of recording, however, tend to decrease the reliability of the individual values.

Gradients and relative values are considered to be reliable.

SEA LEVEL PRESSURE – This element is one of the most frequently recorded but is one of the least accurate because of instrument and coding errors. Barometers used on shipboard require more frequent calibration than they usually receive to be capable of registering accurate pressure readings. Despite the inaccuracies of the individual readings, however, the large scale patterns and mean gradients are relatively accurate.

AIR TEMPERATURE – Air temperature readings recorded on transient ships in warm, sunny weather appear to be consistently high. The reason is thought to be improper instrument exposure.

VISIBILITY – It is difficult to measure visibility at sea because of the lack of reference points. Also, some observers report reduced visibilities at night because of darkness. The coarseness of the coding intervals, however, tends to minimize serious biases in the summarized data.

WAVE DATA – Waves are the least often recorded element in marine observations. Also, the estimate of wave heights is very subjective and depends upon the experience of the observer and the size of the ship from which the observation is taken. Wave heights reported by most transient ships tend to be underestimated in comparison to those recorded by Ocean Weather Stations and dictated by the synoptic situation.

Despite the lower confidence level in the individual values of these elements, through subjective analyses and keying to the OWS data, the means, extremes and gradients presented by the isopleths are considered to be quite reliable.

THE ISOPLETH ANALYSES

The climatic data in this atlas are presented by isopleths (lines connecting points of equal magnitude) supplemented by graphs and tables.

The isopleth analyses were completed cooperatively by a team of analysts under the general supervision of the author. The basic maps were automatically plotted from one or two degree square summaries for the entire ocean area. The Ocean Weather Station data were used as bench marks.

As a further aid to data interpretation, the analysts made use of the observation count which was plotted with all summarized data. Additionally, continuing reference was made to the marine atlases and supplemental publications listed in the bibliography.

Deviations from the data computed for the representative areas and the one and two degree subsquares were in all cases discussed and evaluated by the Editorial Committee before the analyses were finalized.

THE GRAPHS AND TABLES

To supplement the isopleth analyses, graphs and tables are presented for each of the Ocean Weather Stations and the representative areas.

The graphs and tables, in most instances, represent the objective compilation of available raw data for specified areas without regard to suspected biases or inconsistencies.

THE INDIVIDUAL SURFACE CHARTS

The legend in the lower right corner of each chart is designed to explain chart content – the graphs, isopleths or both. Detailed instructions telling how to read the graphs are given and explanatory notes are included as far as practicable. The following paragraphs contain additional remarks likely to be of interest to those called upon to interpret the charts and graphs and provide answers to specific operational questions.

Most of the graphs and tables are presented in a form to facilitate the approximate determination of the empirical probability of the occurrence of selected criteria. This is an important factor in assessing the risk involved in operational planning. For certain elements for which means may be estimated from the isopleth analyses, sample standard deviations are given on the graphs providing a measure of the relative variability of the parameter or element values. The standard deviation on these graphs is denoted by a lower case sigma (σ) with a subscript (e.g., "p", which identifies pressure as the element). The standard deviation was computed using the expression:

$$\sigma_x = \left[\frac{N \sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i \right)^2}{N(N-1)} \right]^{\frac{1}{2}}$$

where N denotes the number of observations in the sample and x_i denotes the ith value of the random variable **X**. The use of (N-1) in the denominator gives the best estimate of the population standard deviation.

SURFACE WINDS

Surface wind is the element most commonly observed and recorded. It was the element considered basic in the selection of representative areas for construction of complete frequency distributions.

Wind distribution is presented by means of a combination of two graphic forms – the bar graph and the contingency table. The bar graph corresponds to the percent scale at the top of the square and gives ready reference to the wind direction frequency. The contingency table gives the percent frequency of each wind speed class within each direction. By adding the totals lines at the bottom of the graph it is possible to determine cumulative percent frequency of wind speed below the selected threshold values. In the example chart in the legend, 71% of all winds were < 17 knots.

Because of the continuous record at the Ocean Weather Station locations, it is possible to compute duration statistics for gales. These graphs are printed over or immediately adjacent to the respective locations of the OWS's in the base chart. The legends are self explanatory and show durations of wind ≥34 knots as well as recurrence intervals.

AIR TEMPERATURE

The threshold values of ≤0 °C and ≥20 °C for the isopleths of air temperature were selected in response to requests by a number of users consulted who considered these as operationally significant.

The mean temperature for each wind direction and calm are shown by dots in the graph opposite each direction and corresponding to the temperature scale at the bottom. Note the temperature range on the scale may vary from area to area and month to month. Also, the scale shifts to larger intervals in a few cases because of the larger range of values for that particular area or month.

T-H INDEX AND TEMPERATURE EXTREMES

The American Society of Heating and Ventilating, as early as 1923, introduced a term called "effective temp-

erature" which is a measure of comfort based on temperature and humidity. This is the term we call THI (Temperature – Humidity Index) and is computed by the following equation, adapted from one described by E. C. Thom, 1957:

$$THI = 0.4\,(T_d + T_{wb}) + 4.7778$$

where: T_d = Dry Bulb Temperature (°C)
T_{wb} = Wet Bulb Temperature (°C)
THI is in degrees Celsius

It has been empirically determined that a majority of people will be uncomfortable by the time this figure reaches 24 °C.

Isopleths of the 1% and 99% levels of air temperature have been selected to present extreme conditions.

The graphs show air temperature versus wind speed. Use may be made of these charts to determine the extent of discomfort likely because of extreme heat or cold. They may also be used to estimate the likelihood of superstructure icing.

Ice accretion is a complicated process that depends upon sea conditions, temperature, wind and the size and behavior of the ship. Superstructure icing affects all ships but is more dangerous for smaller vessels. Icing potential exists when the air temperature falls below the freezing temperature of sea water (usually about −2 °C) with the wind equal to or greater than 11 knots. The lower the temperature and higher the wind speed, the greater the potential for superstructure icing and it may become quite severe with temperatures −9 °C and wind 34 knots.

SEA SURFACE TEMPERATURE

Sea surface temperature is an element which is recorded with a fairly high frequency in marine observations. The 1% and 99% isopleths give qualitative estimates of the extremes that may be encountered at any location.

Note that the temperature range on the cumulative percent frequency graphs may vary from area to area and month to month. Also, the scale changes to larger intervals on some graphs because of the larger range encountered in areas where warm and cold ocean currents are in close proximity.

The mean sea surface temperature may be used to estimate the approximate time a man in ordinary clothes and life preserver may be expected to survive if washed overboard:

Water Temperature	Exhaustion or Unconsciousness	Expected Time of Survival
0 °C	15 min	15 to 45 min
0-5 °C	15-30 min	30 to 90 min
5-10 °C	30-60 min	1 to 3 hrs
10-15 °C	1-2 hrs	1 to 6 hrs
15-20 °C	2-7 hrs	2 to 40 hrs
20-25 °C	3-12 hrs	3 to indefinite hrs
25 °C	Indefinite	Indefinite

HUMIDITY

Moisture content of the atmosphere is another element which is recorded relatively infrequently in observations taken by transient ships. It is, however, recorded on nearly all of the OWS observations. The dew-point temperature analyses on this chart are keyed to the means computed at the OWS's.

The 1% and 99% dew-point temperature isopleths give qualitative estimates of extremes of this element that may be encountered at any location.

The cumulative percent frequency of wet-bulb temperatures may be read along the solid line with values on the scale at the top of the graph. The cumulative percent frequency of relative humidity may be read along the dashed line with values on the scale at the bottom of the graph.

PRECIPITATION

The treatment of the data with respect to precipitation type has been changed from the previous atlas. Instead of percent frequency of present weather observations reporting frozen precipitation which included freezing drizzle and freezing rain along with snow, in this volume the percent frequency of *precipitation* observations reporting *snow* is given. Freezing rain and freezing drizzle are not considered to be "frozen" precipitation since the moisture freezes after it falls.

In an effort to bring the percent frequencies of precipitation as reported by OWS's and transient ships more in line, present weather codes 20-27 (precipitation within the past hour) were counted in the precipitation totals for the transient ships. The graphs for the representative areas were computed from these revised data.

The percent frequency of all observations reporting precipitation is printed in the upper right corner of each graph. The bar graph gives the percent frequency of precipitation which occurs with each wind direction or calm. The reader is reminded that this graph is based on precipitation frequency and not on wind direction frequency. If the reader is interested in determining the percent frequency of winds from any direction, he should refer to the surface wind chart.

VISIBILITY

The cumulative percent frequency of horizontal visibility is presented by nautical mile class intervals rather than by kilometers. The percentage of horizontal visibility equal to or greater than 25 nautical miles can be obtained by subtracting from 100% the cumulative percent frequency at the point 25 on each graph. Caution is advised, however, in interpreting these areas since, because of curvature of the earth, it is virtually impossible to see 25 miles horizontally from the bridge of most ships. The supplemental table at the bottom of the graph gives percentage of visibilities 2 nautical miles which occurred with each wind direction and calm.

CLOUD COVER

In the previous atlas series the confidence level of low cloud amount statistics was deemed to be quite low. This was because of a number of reasons, one of the main ones being the extremely low frequency of recording of this element. In the present atlas, because of the increased data base, the reliability of low cloud data has improved. The total cloud amount element does not suffer from this deficiency to so great an extent. The number of observations available which contain only total clouds amount continues to be higher than those containing both low and total.

In the analysis of these data, the OWS's were used as benchmarks. Cloud patterns derived from the marine observations and those depicted by satellites show fairly close agreement (U.S. Department of Commerce and United States Air Force, *Global Atlas of Relative Cloud Cover, 1967-70*, Washington, 1971).

The observation count on the graphs is that of obser-

vations containing total cloud amount. Since it was not required that observations contain both total and low cloud amounts, the number of observations with low cloud amount is less than that for total cloud. Thus, two different populations are used to compute the cumulative percent frequency curves for the total and low cloud amounts. This leads to inconsistencies where low cloud amount appears higher than the total cloud amount. In all cases these were resolved in favor of the total cloud by making the frequency curves coincide.

The cumulative percent frequency of any cloud amount equal to or less than the amount intersected by the curve may be read for total cloud along the solid line or low cloud along the dashed line. The frequency of obscured conditions may be determined by subtracting from 100% the cumulative percentage frequency corresponding to 8/8 coverage. The bar graph portion of the figure shows the percent frequency of low cloud amount equal to or greater than 5/8 and equal to or greater than 7/8 with each wind direction and calm (obscurations are considered as 8/8 coverage for these purposes).

CEILING AND VISIBILITY

Simultaneous ceiling-visibility contingencies are presented in isopleth and tabular form. They are designed as an aid to situations where both vertical and horizontal visibility are the major items of concern.

WIND - VISIBILITY - CLOUDINESS

This series of charts is designed to give the planner a qualitative estimate of the probability of occurrence of certain significant operational conditions. The conditions for optimum and poor carrier operations are those recommended by the users of the earlier atlas series. Of the elements used in these statistics, height of low cloud ceiling has the least reliability in the case of transient ship observations. The analyses were accomplished, however, by keying to the OWS data and adjusting the isopleths over the remainder of the area.

It should be noted that in both the contingency tables and the isopleths, the poor carrier operation conditions are *and/or* situations. This means if any one of the poor conditions of ceilings, visibility or wind speed exists, the event is counted under poor. However, in the case of optimum conditions it is an *and* situation. That is, the ceiling must be ≥ 5000 feet *and* visibility ≥ 5 nautical miles *and* wind 11-21 knots.

SEA LEVEL PRESSURE AND MEAN WIND

Two sets of wind statistics are presented. The vector mean wind is shown by arrows (direction of flow toward the station dot with the magnitude of the vector plotted at the end of the arrow). The scalar mean speed without regard to direction is shown by isopleth analysis. In areas of high persistence of direction, the magnitude of the mean vector should approximate the scalar mean speed. Pressure graphs and charts are shown.

WAVES (<1.5 AND <2.5 METERS)

In these analyses, the higher of the sea or swell is selected for summarization. If the heights are equal, the wave with the longer period is selected.

In order to present as broad a spectrum of heights and periods as practicable, two sets of wave charts are furnished.

The graphs accompanying the wave heights < 1.5 and < 2.5 meter analyses are wave height versus wave direction. The bar graph and the percent scale at the top of the chart give the percent frequency of waves from each direction. Indeterminate directions are combined with calms. The percent frequency of wave heights (bottom scale) may be read for each height interval and wave direction from the contingency table. The isopleth analyses of the percent frequency of heights < 1.5 and < 2.5 meters are for generally non-hazardous sea conditions.

WAVES (≥3.5 AND ≥6 METERS)

Wave heights in the ≥ 3.5 and ≥ 6 meter range represent increasingly hazardous conditions. Accompanying these charts are contingency tables of wave heights versus period.

LOW PRESSURE CENTERS

The roses, tracks and cyclogenetical areas are based on 9 years of track charts (May 1965-April 1974) prepared by the National Meteorological Center. These charts show cyclone tracks based on 6-hourly positions of closed centers. During the past decade, the added dimension of satellite surveillance has helped to improve the reliability of analyses over the oceans. The addition of the later data has confirmed the general positions of the tracks shown by Klein (1957) but some minor adjustments appear to be warranted.

Frequencies of cyclone centers passing through 2½ degree "squares" were analyzed to obtain the mean tracks. Primary tracks were selected along the axes of maximum frequency and secondary tracks were selected along axes where there was a moderate frequency.

The number of individual centers entering the area was subtracted from the number observed in an area to obtain the frequency of origins. These numbers were then analyzed to find regions of cyclogenesis (only formation, not intensification). In order to show that the depicted areas are general as opposed to specific, no borders are drawn around them.

The legend shows how to read the roses. In the model, the figure printed at the end of each bar represents the mean speed of movement (in knots) of all storms which moved toward this direction. The length of the bar represents the percent frequency of centers which moved toward that direction. The scale is given by arcs of circles labeled in percentage. The arcs of circles are also labeled in speed and refer to the mean vector movement as represented by the dot. The top figure within the inner circle represents the number of 12-hour storm movements in the quadrangle during the period of record. The bottom figure indicates the number of individual storms used in the computations.

TROPICAL CYCLONES

The tropical cyclone (wind speeds ≥ 34 knots) roses in this atlas are reprinted from the Mariners Worldwide Climatic Guide to Tropical Storms at Sea, NAVAIR 50-1C-61, 1974.

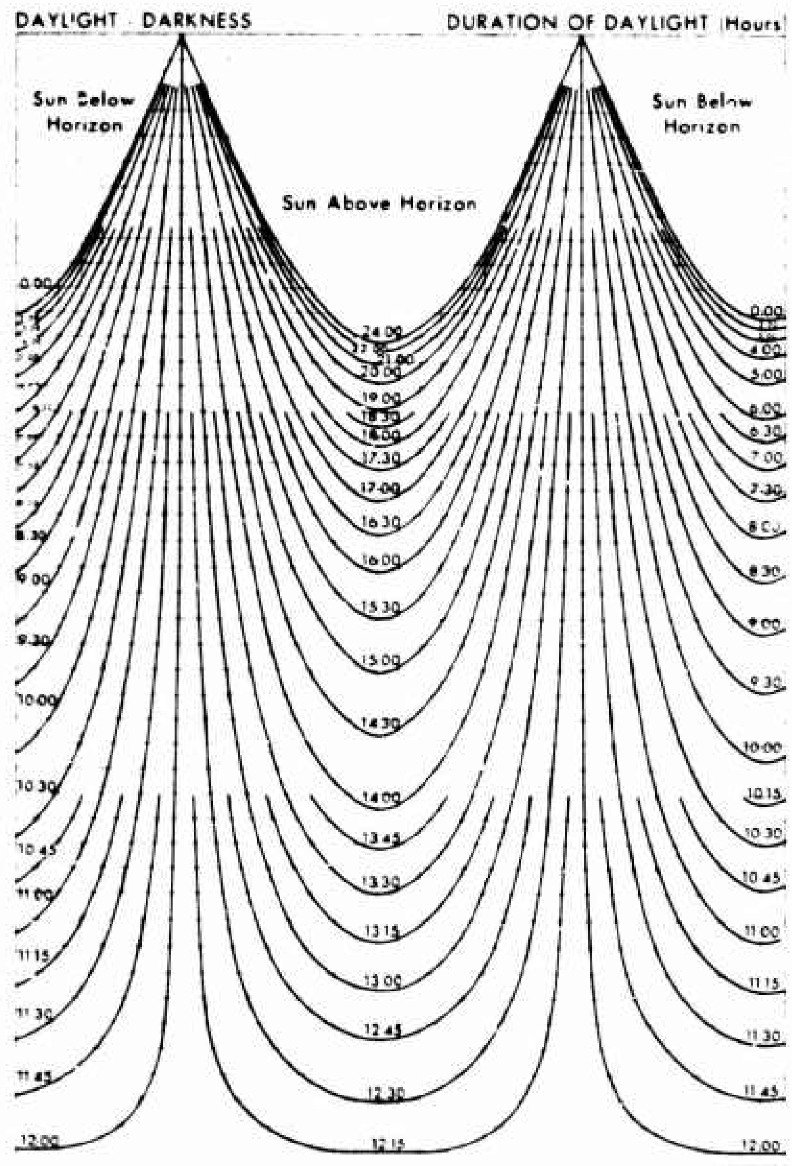
The data presented here are the tropical storm (wind speeds 34-63 knots) and hurricane stages (wind speeds ≥ 64 knots) combined for the 5° quadrangles. The period of record is 1871-1971. The reader is referred to the above mentioned "Guide" for roses of the individual stages.

The rose-type presentation is basically similar to that for low pressure centers except one additional statistic is provided: the lower most number within the rose center indicates the percent of years of record in which storms occurred within the 5° quadrangle.

DAYLIGHT - DARKNESS

This Daylight-Darkness Chart for the Northern Hemisphere defines daylight as the period from sunrise to sunset. As an example, the daylight on July 20 of any year at 48° N is about 15 hours and 30 minutes for any

longitude. The data source was the U.S. Naval Observatory 1945, and is accurate for the entire 20th Century. Further details may be obtained from *The Daylighter* by the Navy Weather Research Facility (1960). Additional light (during twilight) may be usable for many purposes. Duration of daylight in high latitudes (north of about 60°) becomes increasingly dependent upon atmospheric conditions and refraction and there may be some departure from the values depicted on the chart.



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PART II - OCEANOGRAPHY

TIDES

The information presented on the charts (types of tides, cotidal lines, typical tide curves, and tide ranges) was derived from tide tables and tables of tidal harmonic constants. The length of record and the spacing of the observational network along the North Atlantic coast are generally sufficient for most analytical purposes. Similarly, the data used in determining the tidal constituents are adequate, except along Greenland and the western coast of Baffin Bay. However, in these regions enough data were available to provide a reasonably reliable picture of the tidal regimes. The cotidal lines are for the principal lunar semidiurnal tidal constituent and are most accurate for those sections of the North Atlantic where the tides are semidiurnal.

Tides are not considered of practical importance in the open ocean. Hence, there are few measurements in "deep water" and no method has been accepted to date for use by the International Hydrographic Bureau and member nations; the values shown in such areas are only interpretations by Naval Oceanographic Office analysts and are primarily of academic interest.

CURRENTS

The ocean current charts are compiled principally from ship drift reports that were forwarded by the various merchant marines to the Naval Oceanographic Office. As should be expected, the density of observations is greatest, and therefore the reliability of the presentation is best, along the major shipping lanes. From these drift observations the sets and average speeds of the prevailing currents are calculated for each 1° quadrangle. Considerable variation from the directions and speeds of the indicated prevailing currents can be expected, especially in areas where the current system is weak.

Tidal currents are shown where they predominate. These are subject to modifications of speed and direction by winds and other nonperiodic variables.

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ICE

SEA ICE

The ice limits shown on the charts enclose regions with mean ice concentrations of 1 8 or greater. These reflect the average midmonth conditions as determined from all available observations. Actual concentration boundaries may vary widely from the averages under the influence of changing synoptic meteorological and oceanographic situations.

Ice conditions in the westernmost third of the North Atlantic (Canada-West Greenland region) are based primarily on observations collected by U. S. Navy and Canadian ice reconnaissance teams during the years 1952 through 1972. The analysis of the central North Atlantic (East Greenland-Iceland region) was derived from data supplied by U. S. Navy reconnaissance teams and by annual reports of the Danish Meteorological Institute for the period 1919-62. In the easternmost third of the North Atlantic, observations taken at coastal stations and aboard German, Soviet, and Scandinavian ships serve as the main data sources. The Baltic data were extracted from detailed ice reports of the German Hydrographic Institute and the Finnish Institute of Marine Research. Satellite photographs were used to fill gaps in the data.

GLACIER ICE

The mean maximum iceberg limit encompasses most of the observations of drifting glacier ice reported through 1972. Because of the difficulty in differentiating between small amounts of sea ice and glacier ice, all ice sightings made beyond this boundary, regardless of origin, were judged to be exceptional in nature and plotted individually.

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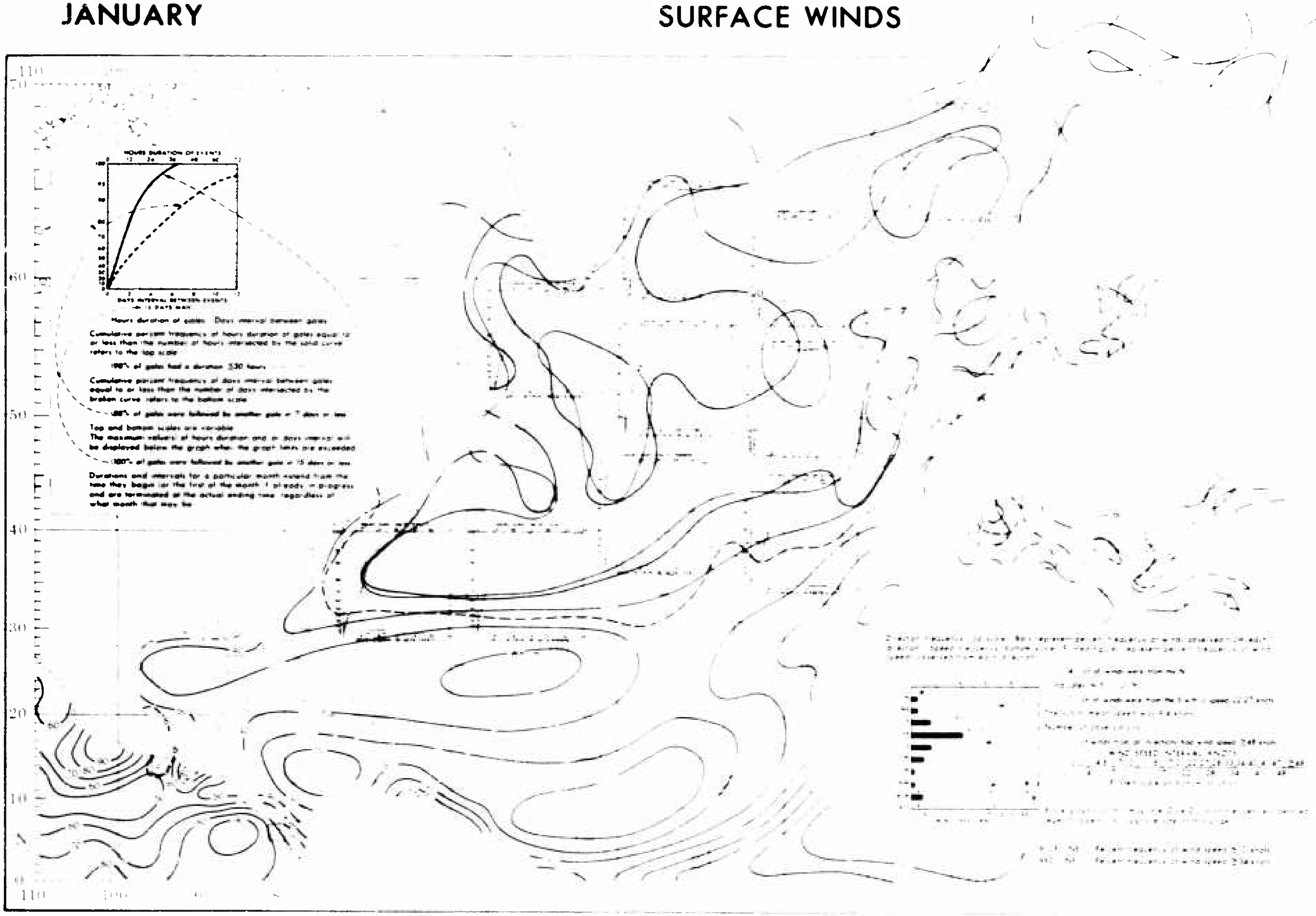
PART I METEOROLOGY

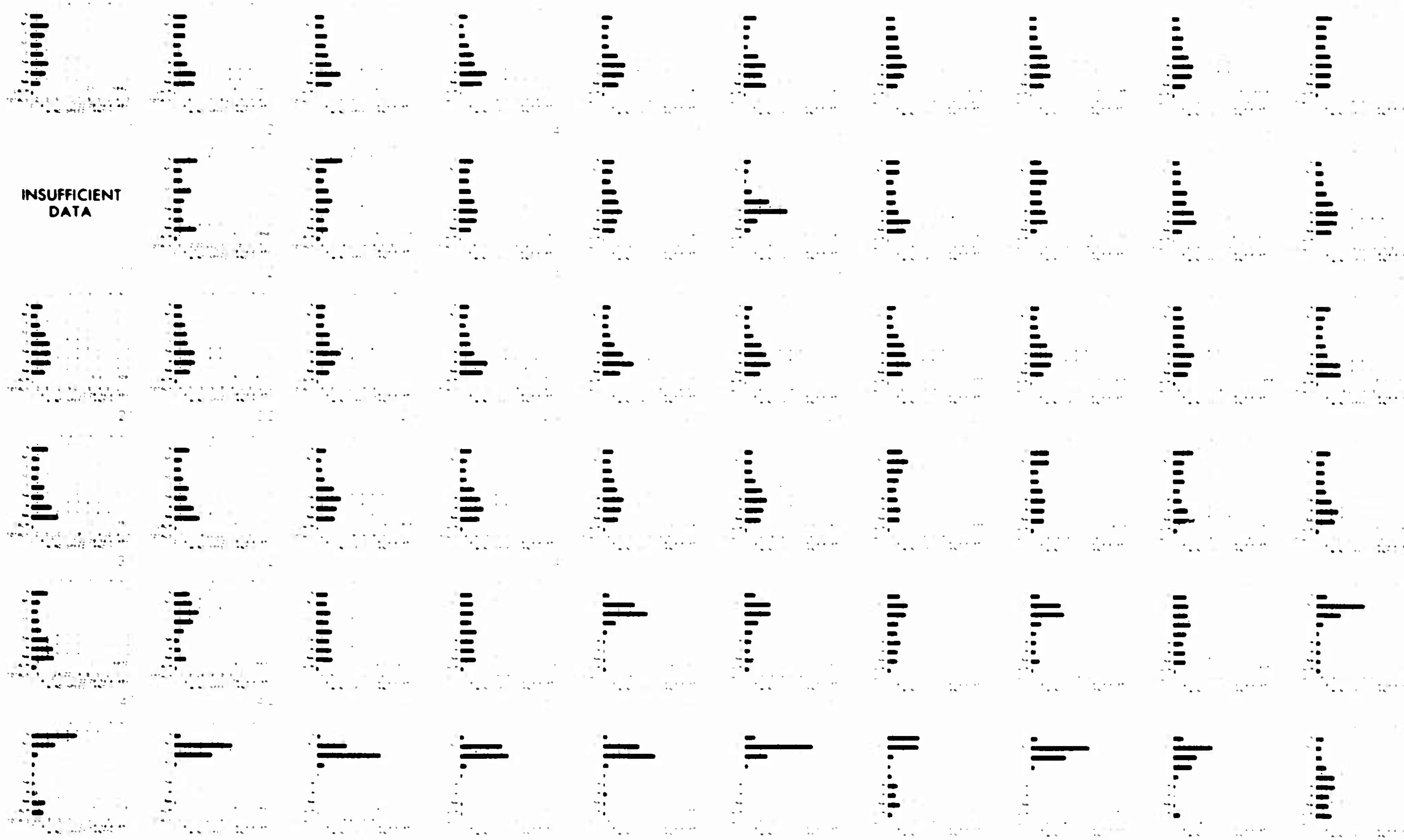
JANUARY

SURFACE WINDS



WIND DIRECTION AND SPEED

JANUARY

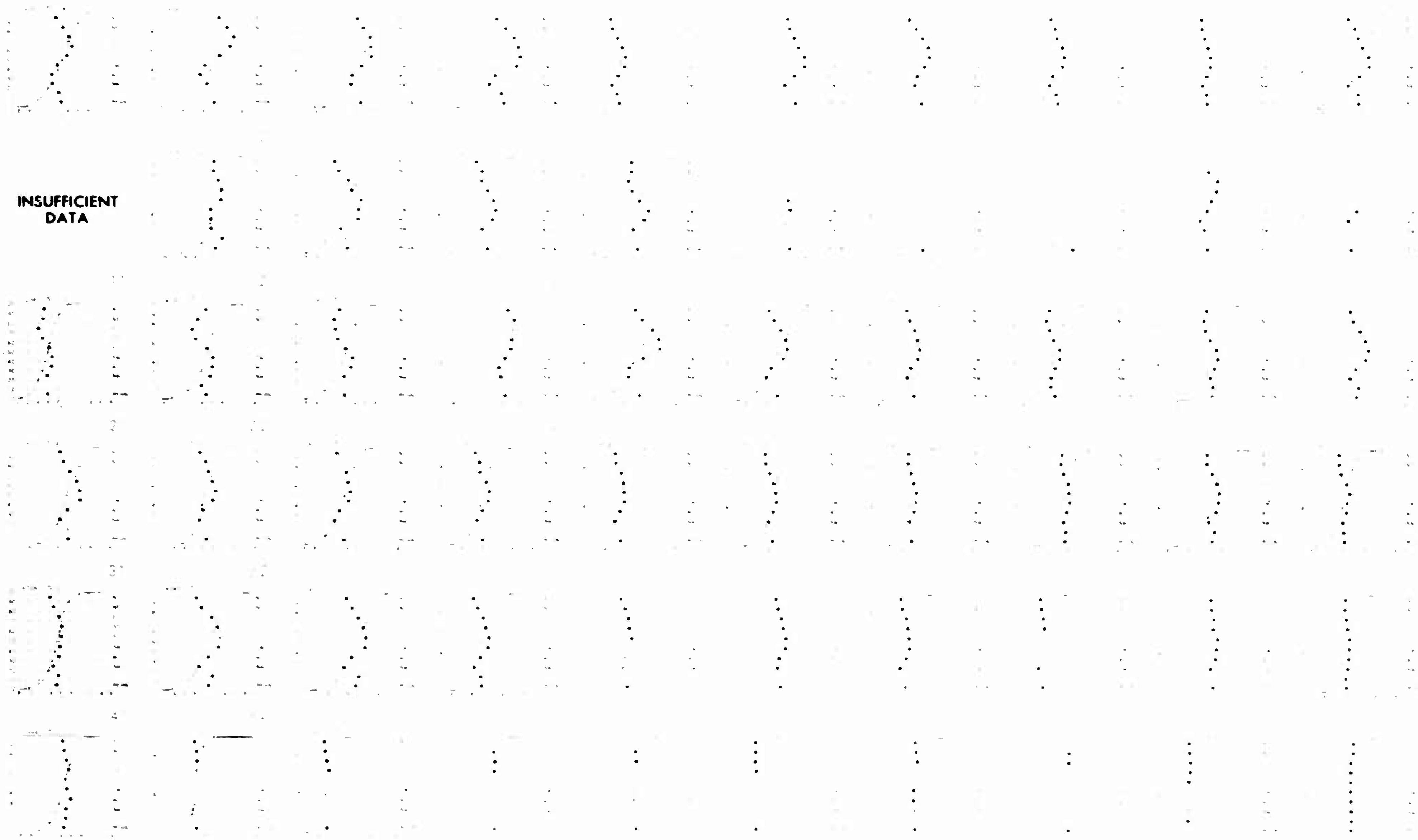


JANUARY

SURFACE AIR TEMPERATURE

SURFACE AIR TEMPERATURE

JANUARY



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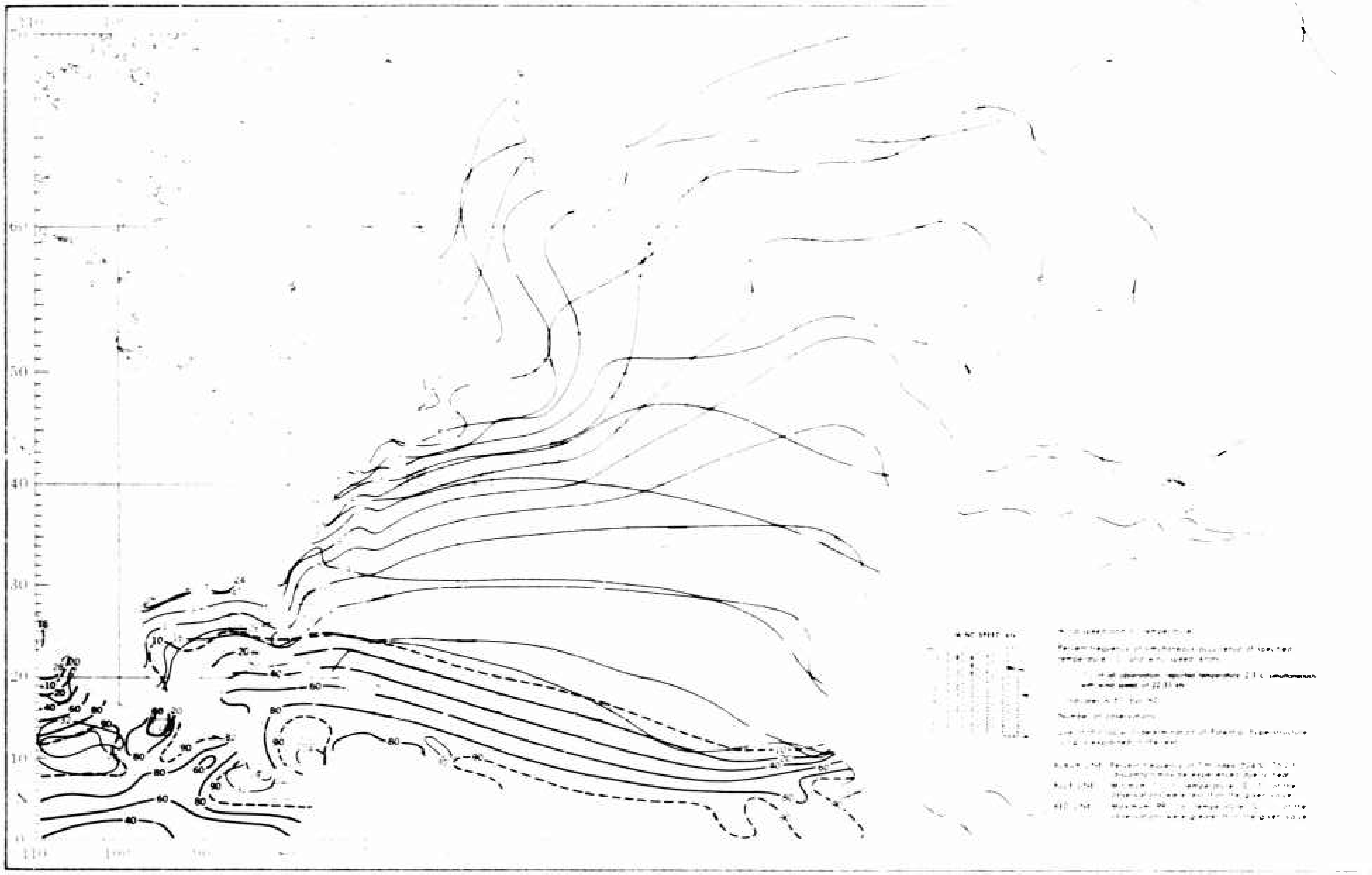


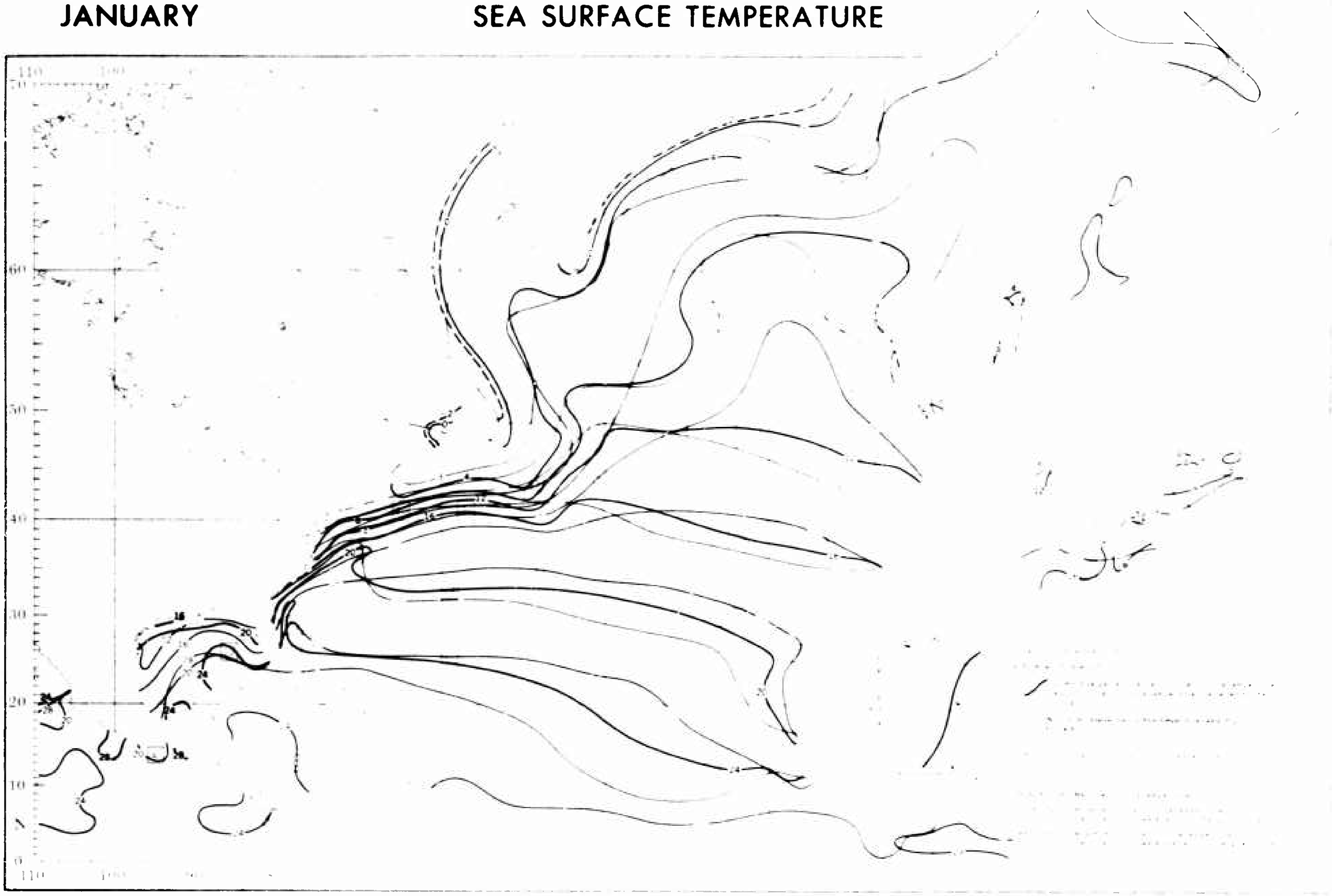
WIND SPEED AND AIR TEMPERATURE

JANUARY

INSUFFICIENT DATA

JANUARY

SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE

JANUARY

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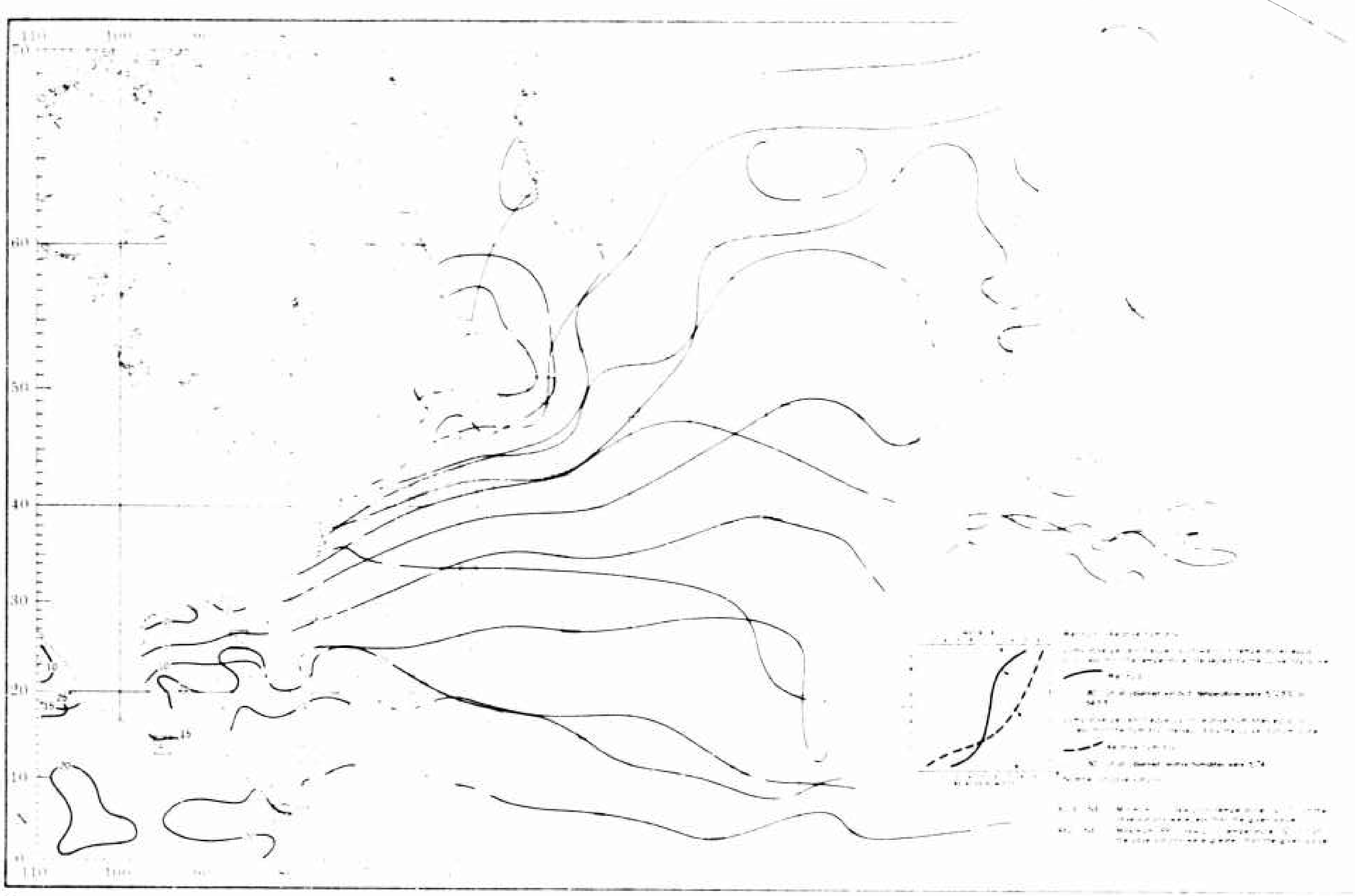
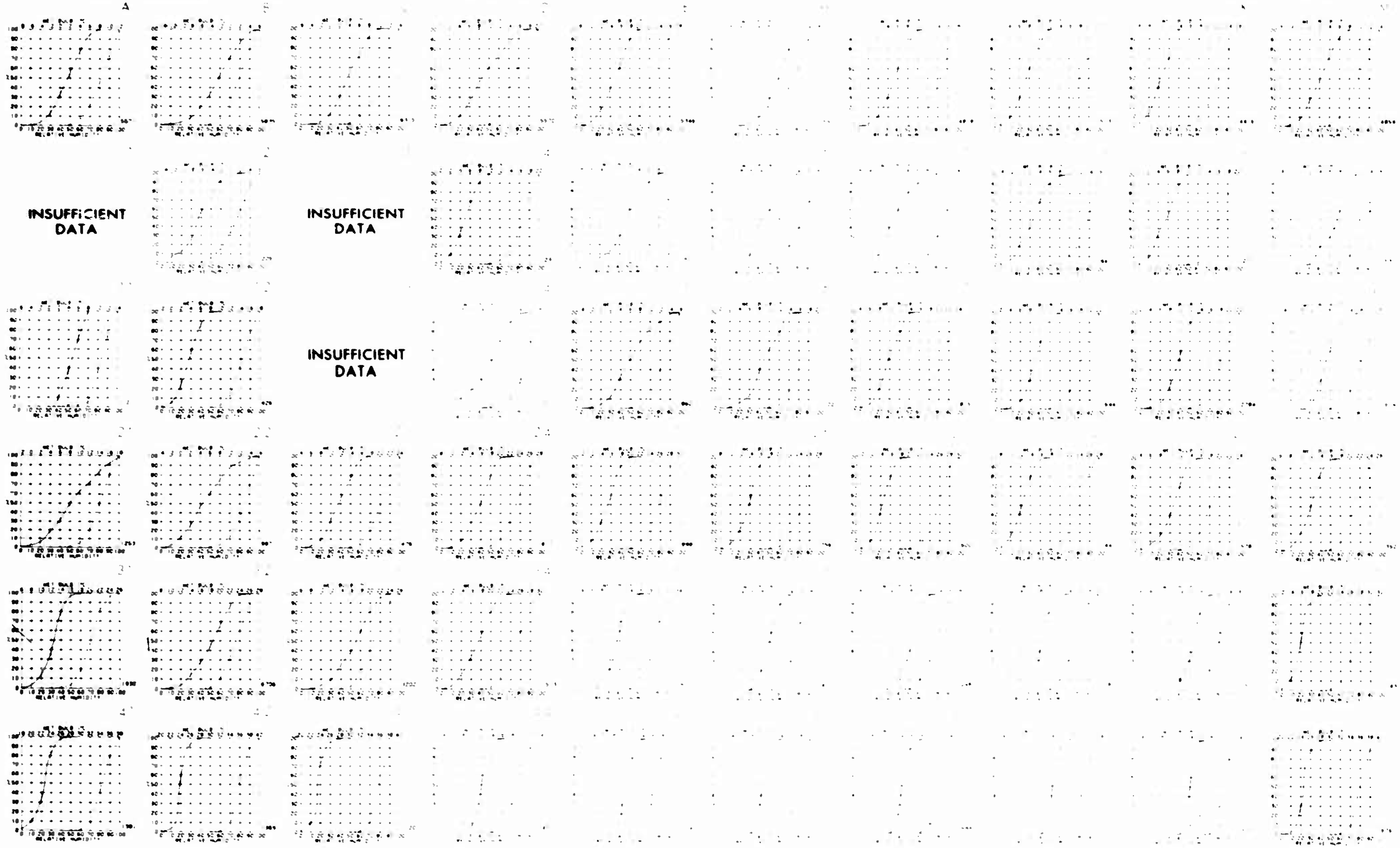


WET BULB AND RELATIVE HUMIDITY — JANUARY



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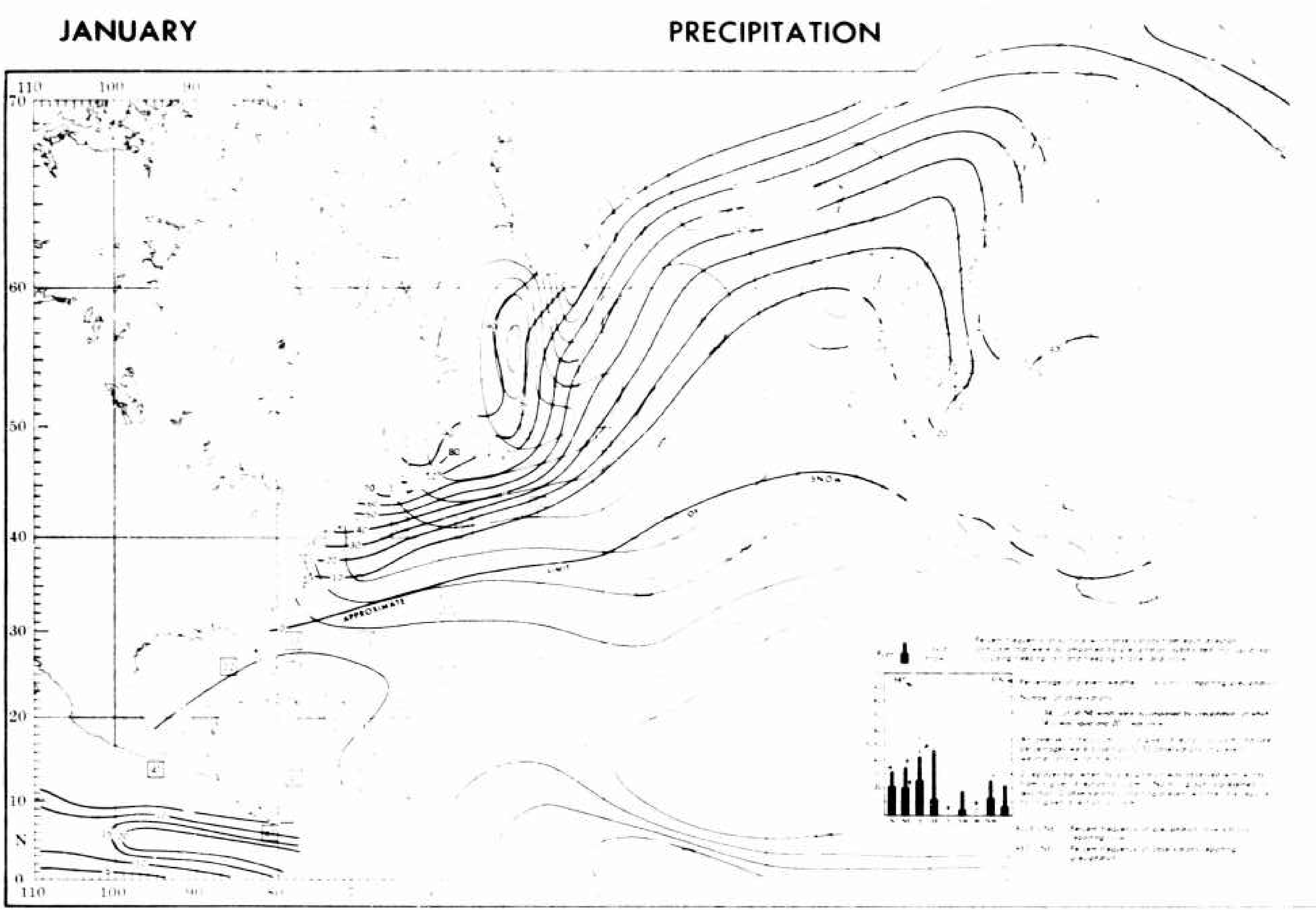

WET BULB AND RELATIVE HUMIDITY

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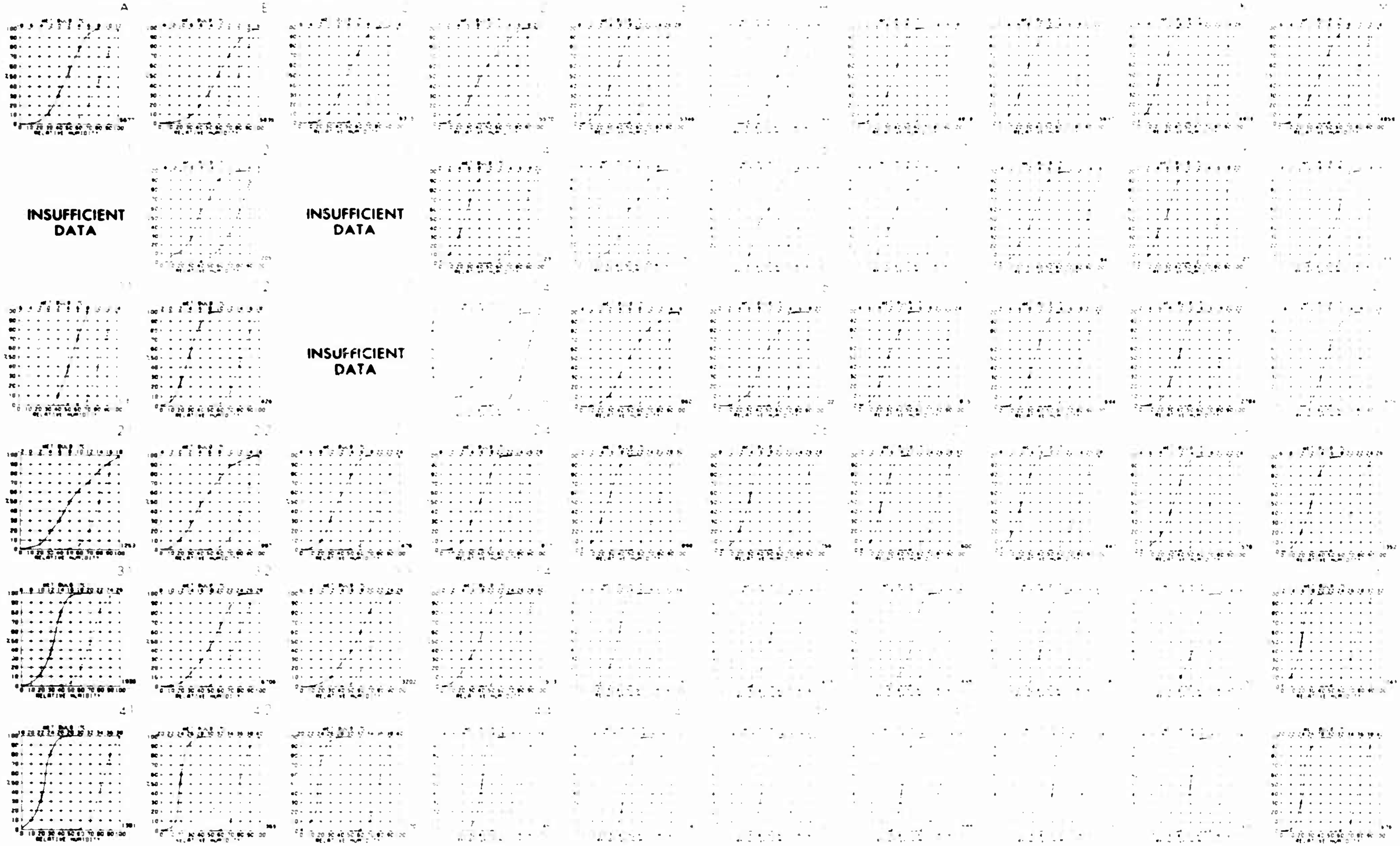

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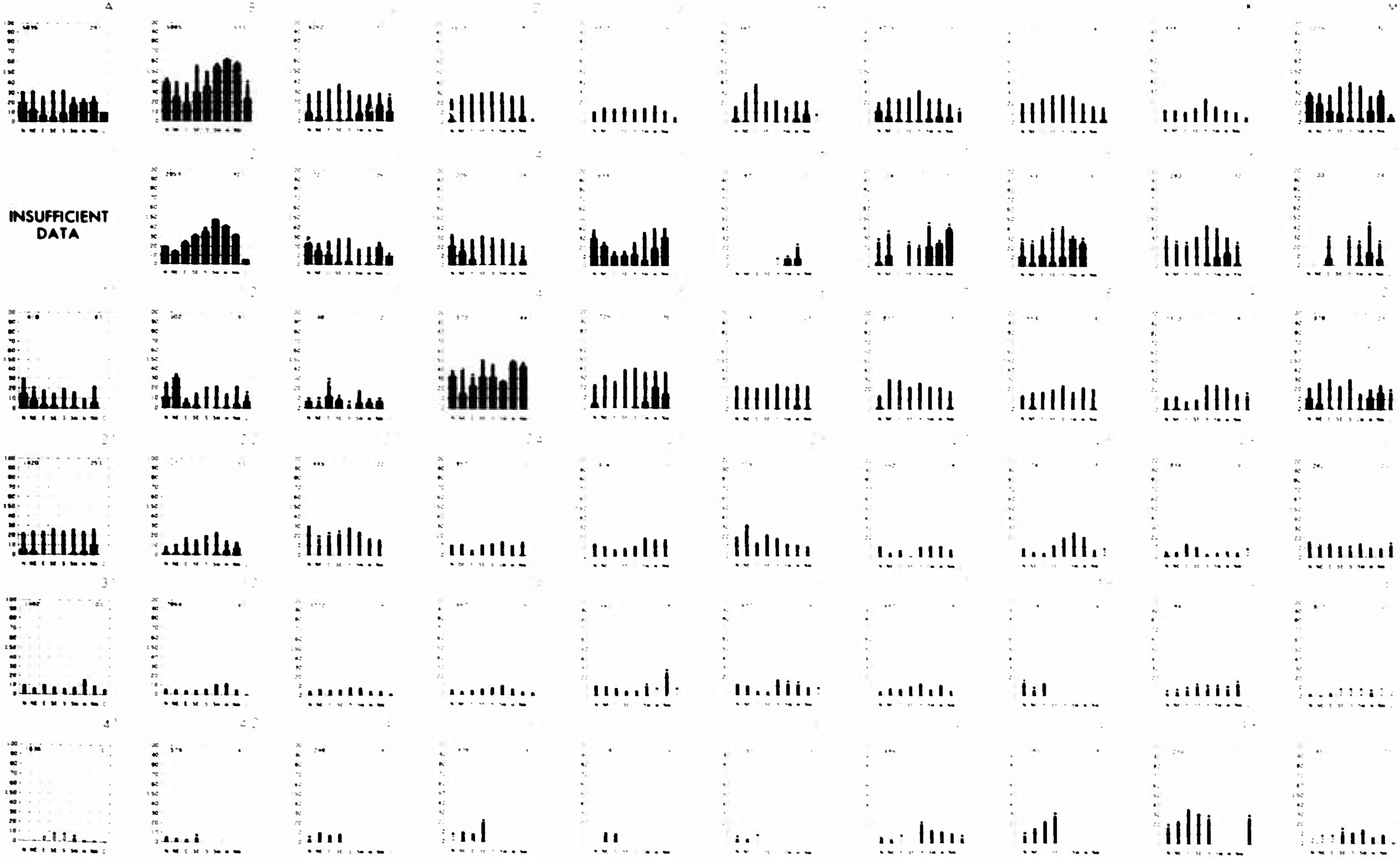
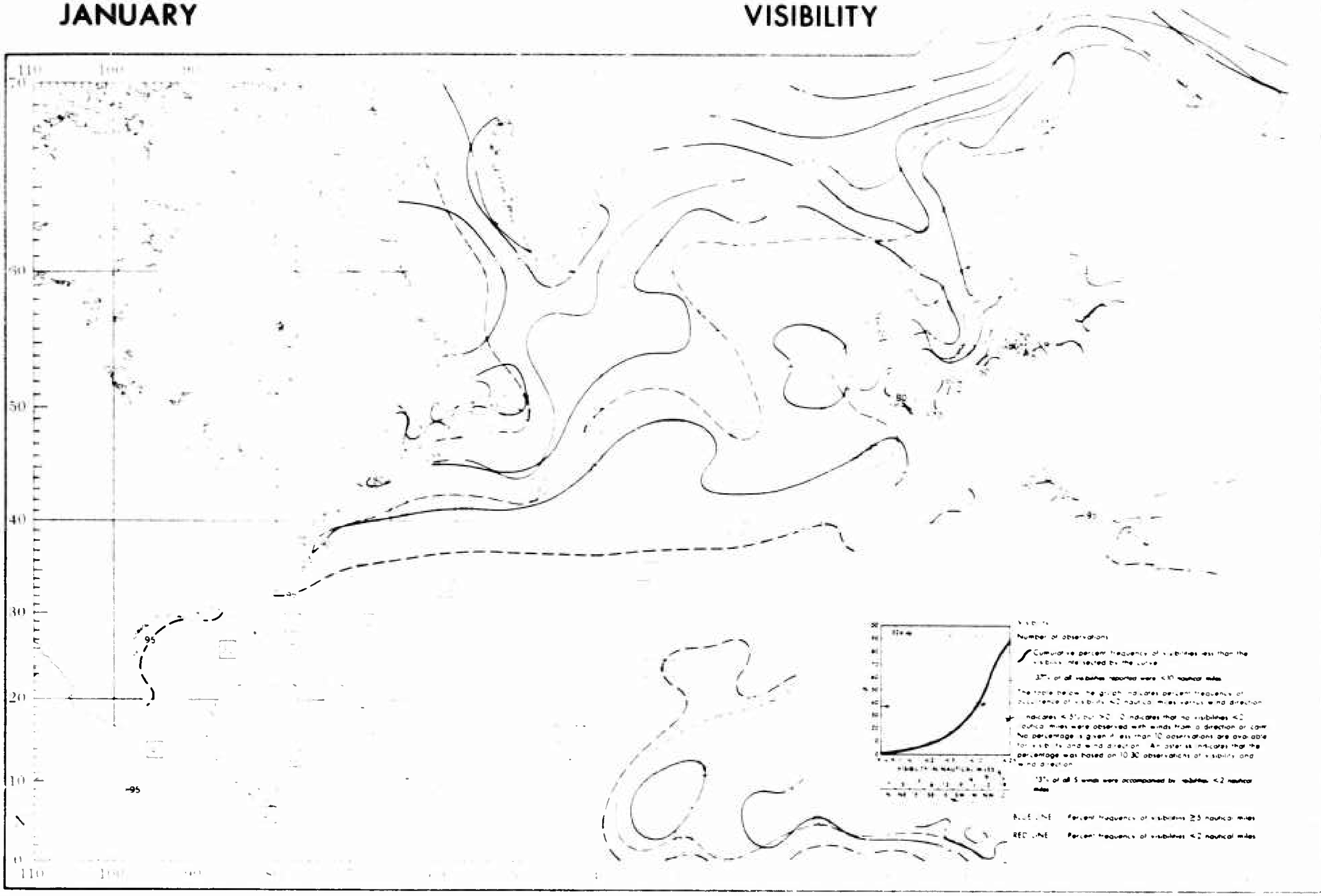


JANUARY

VISIBILITY



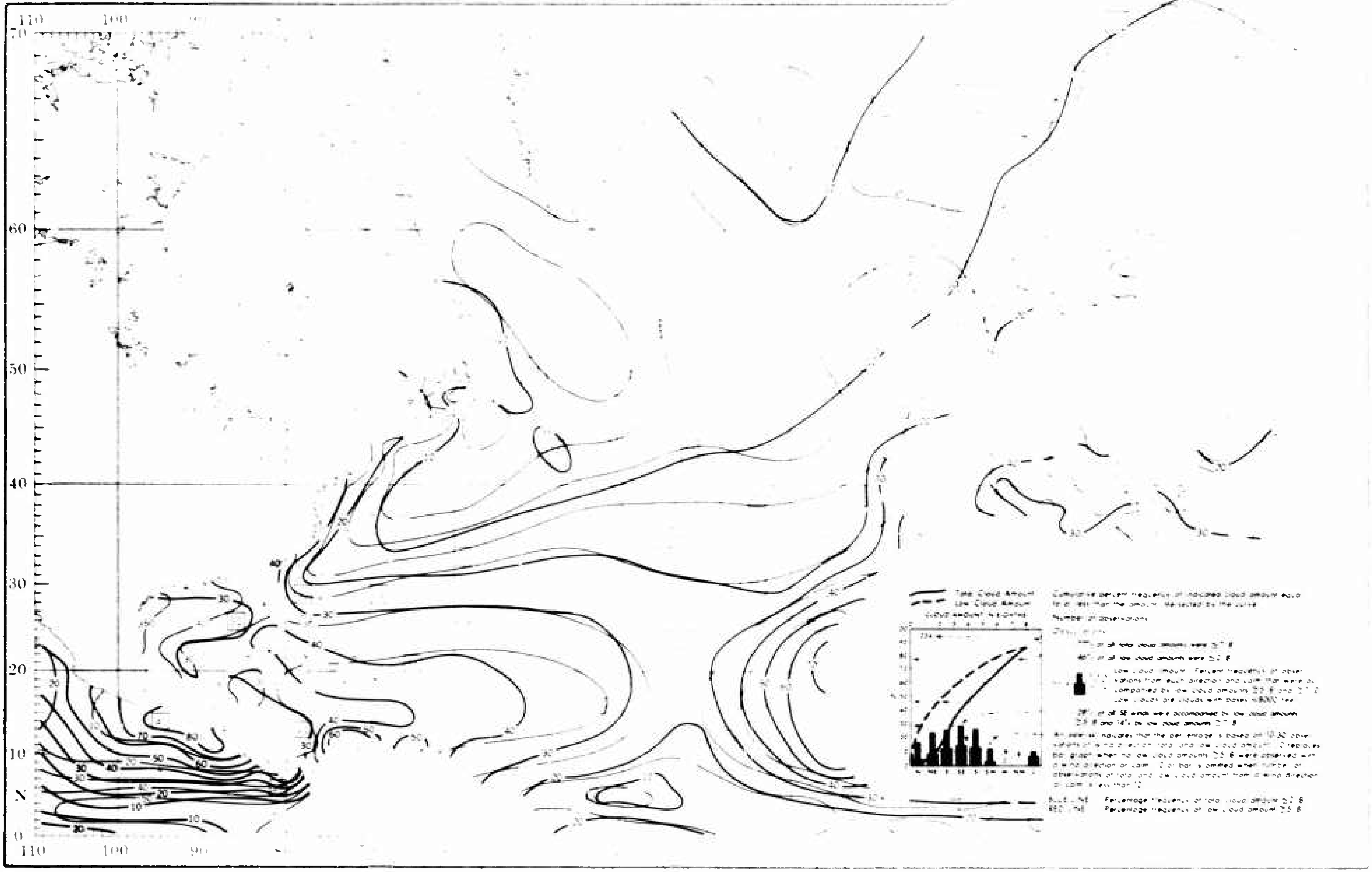
VISIBILITY

JANUARY

INSUFFICIENT DATA

JANUARY

CLOUD COVER



CLOUD COVER

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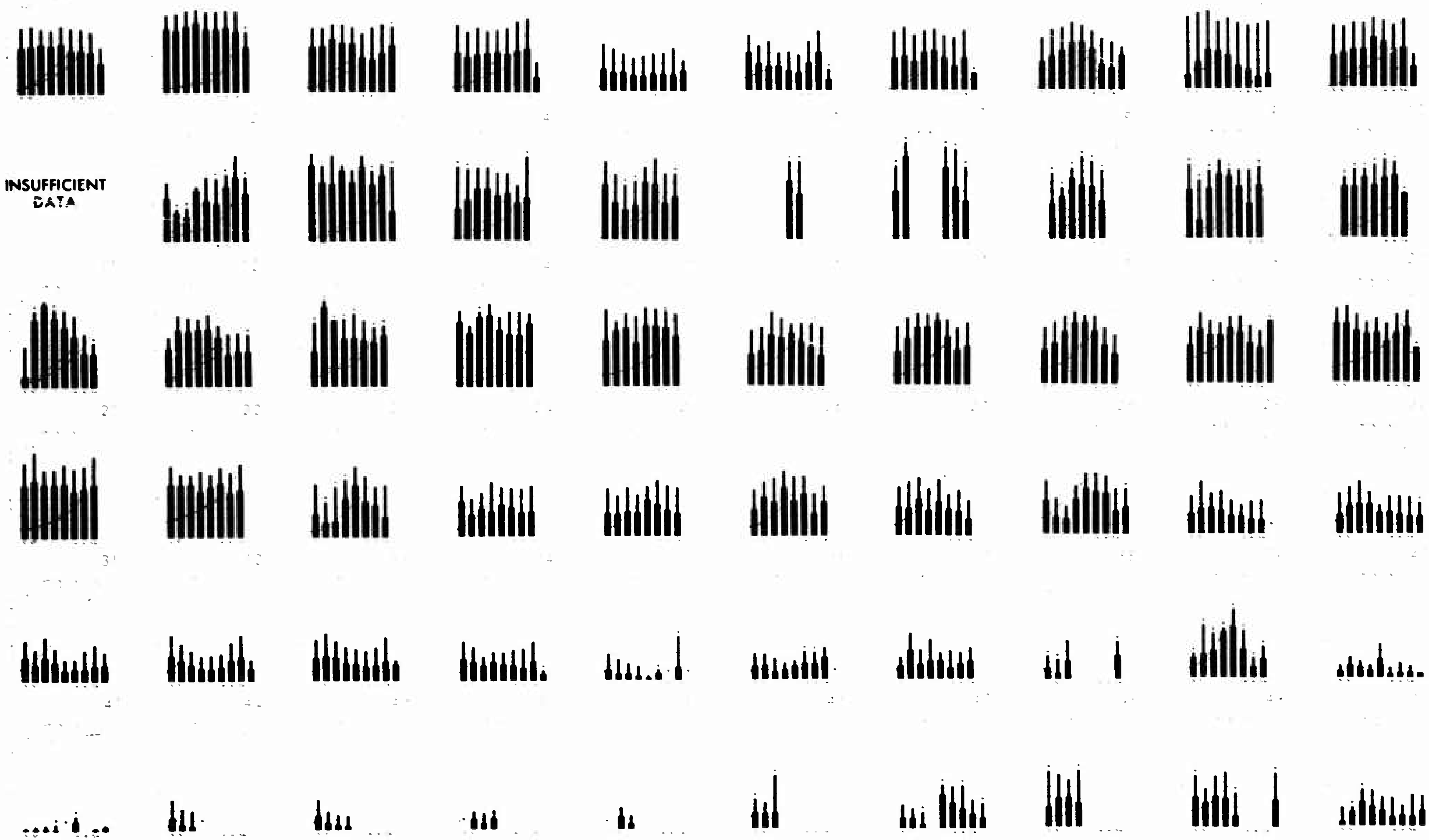
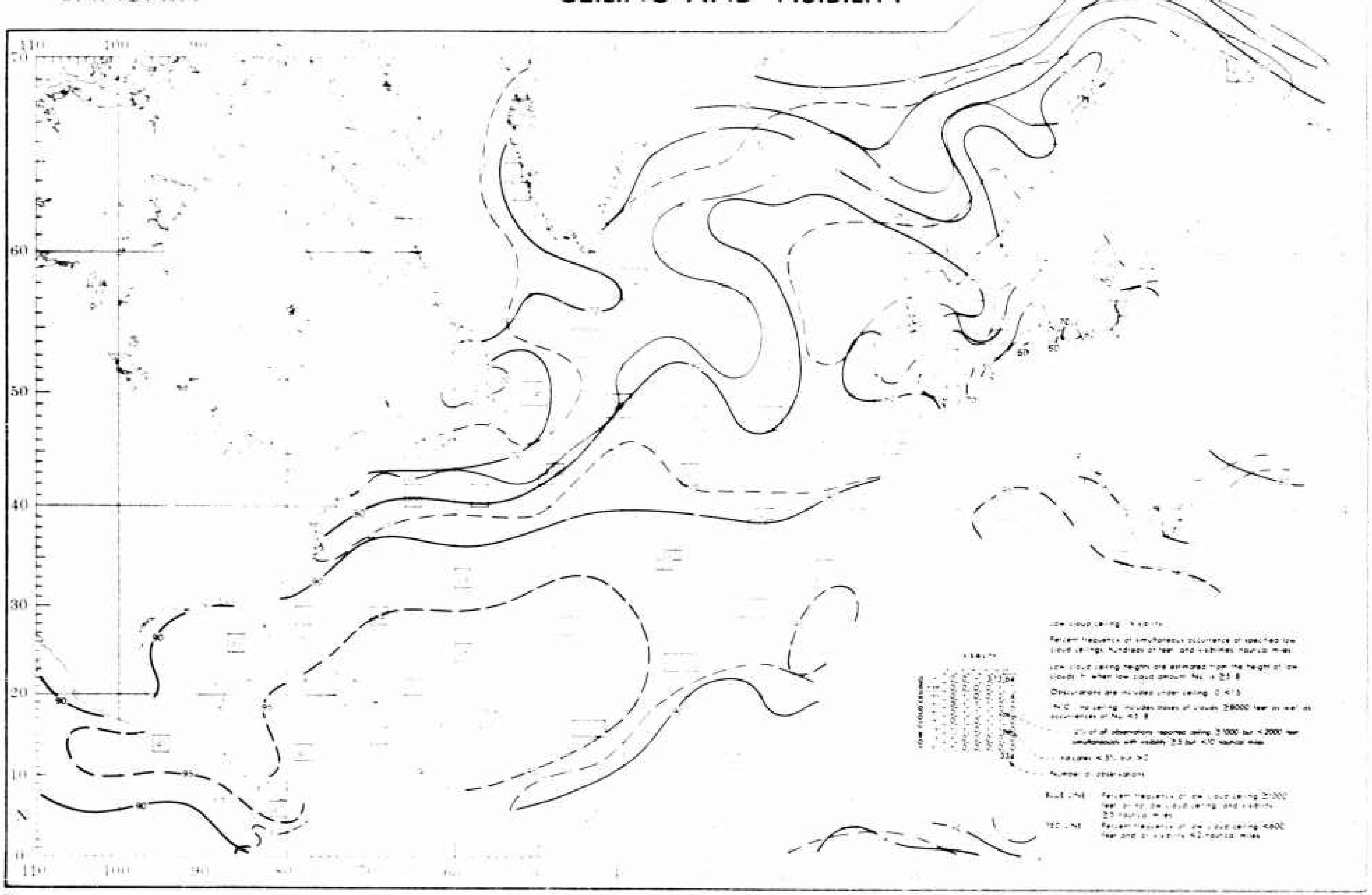


JANUARY

CEILING AND VISIBILITY



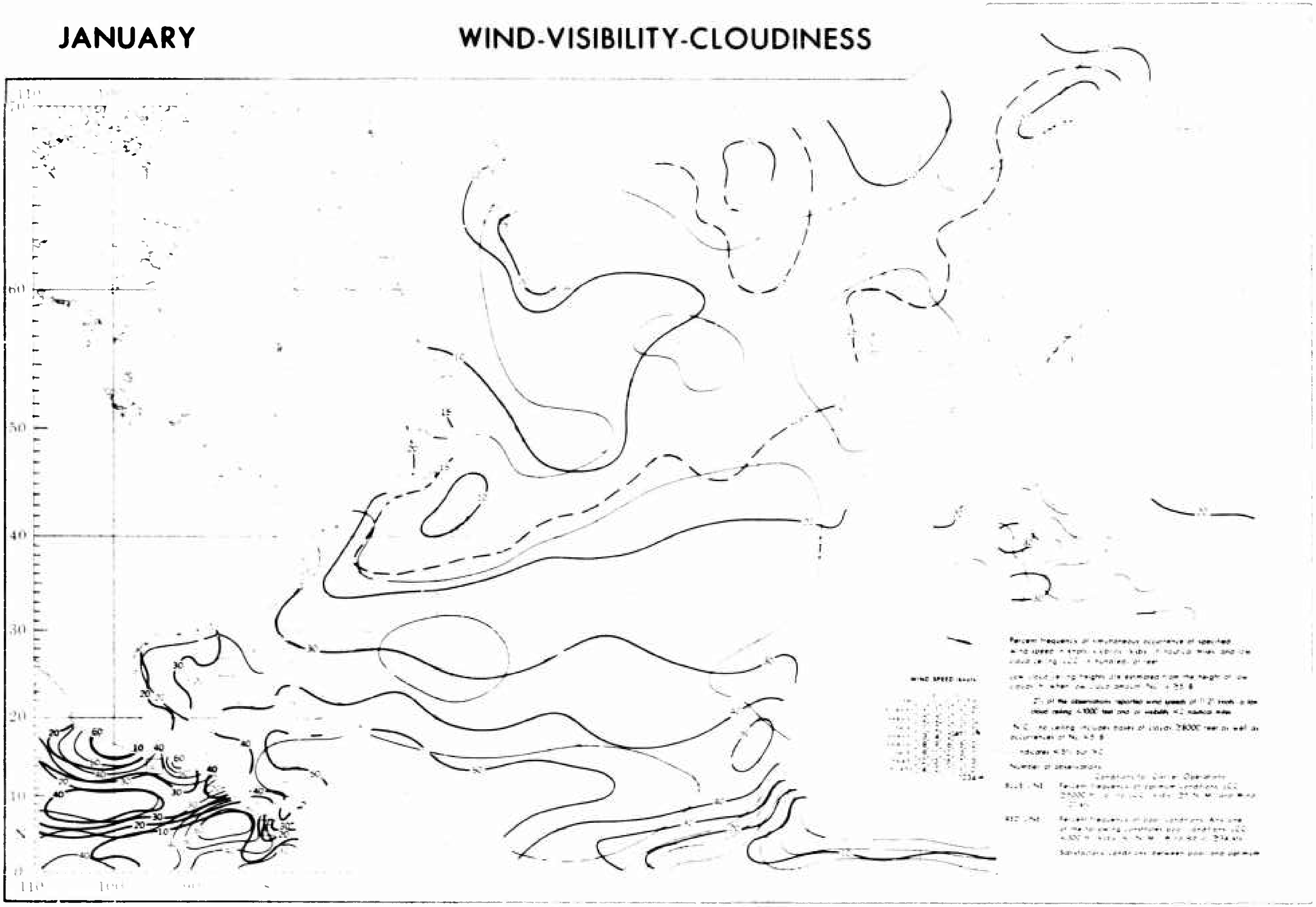
CEILING AND VISIBILITY

JANUARY

INSUFFICIENT DATA

JANUARY

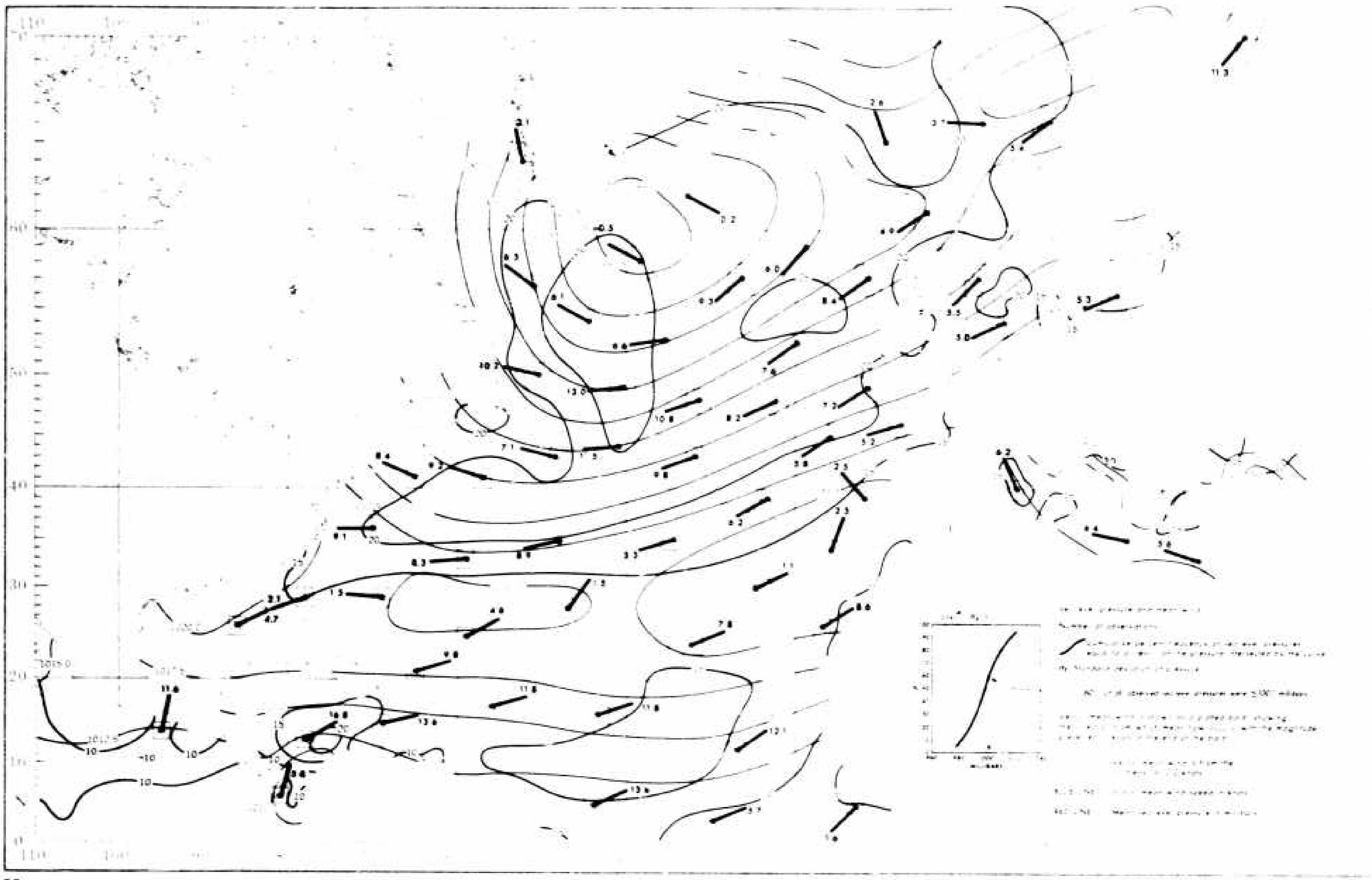
WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

JANUARY

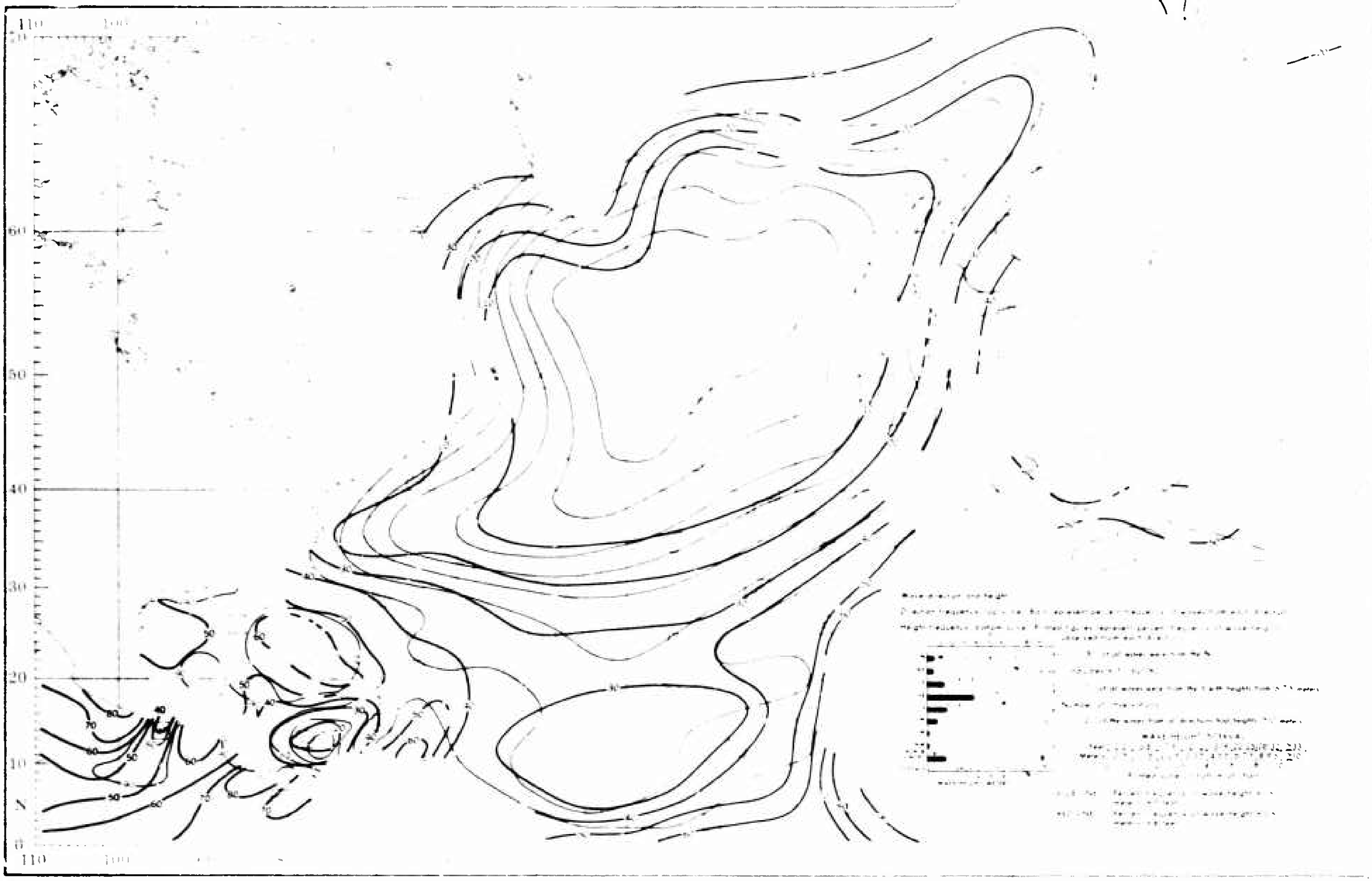
JANUARY SEA-LEVEL PRESSURE AND MEAN WIND



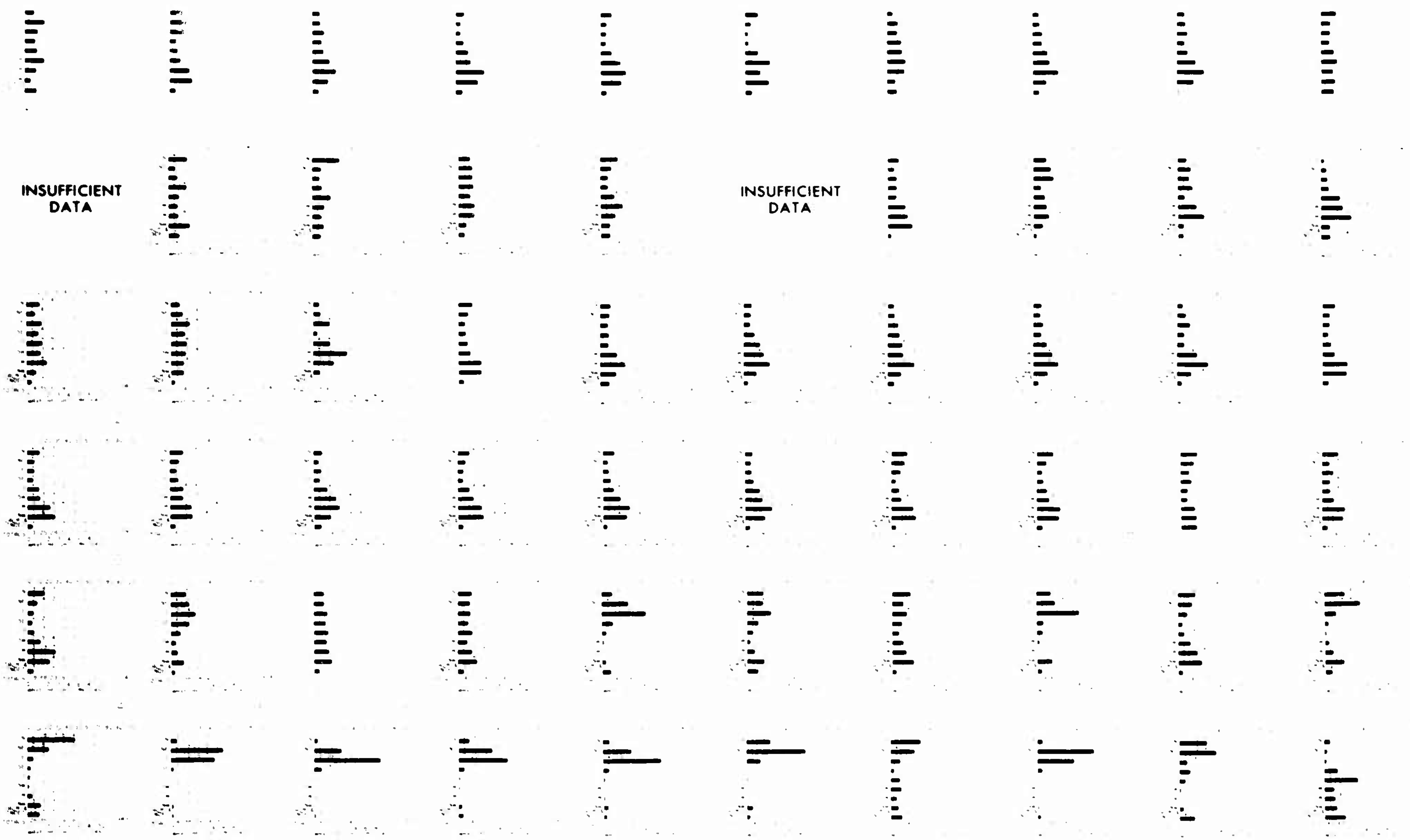
SEA LEVEL PRESSURE

JANUARY

JANUARY WAVES (<1.5 AND <2.5 METERS)

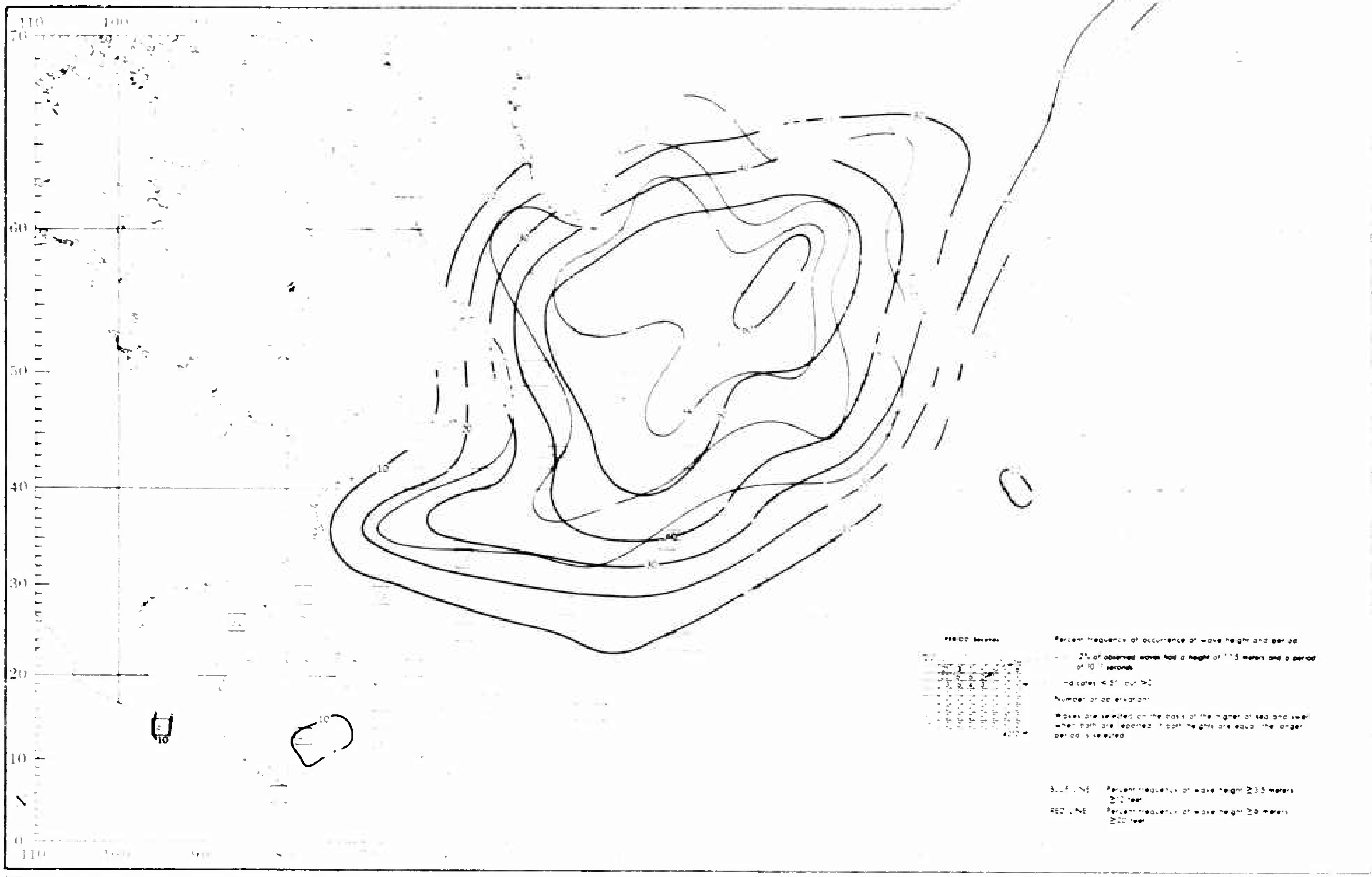


WAVE DIRECTION AND HEIGHT — JANUARY



JANUARY

WAVES (≥3.5 AND ≥6 METERS)



WAVE PERIOD AND HEIGHT

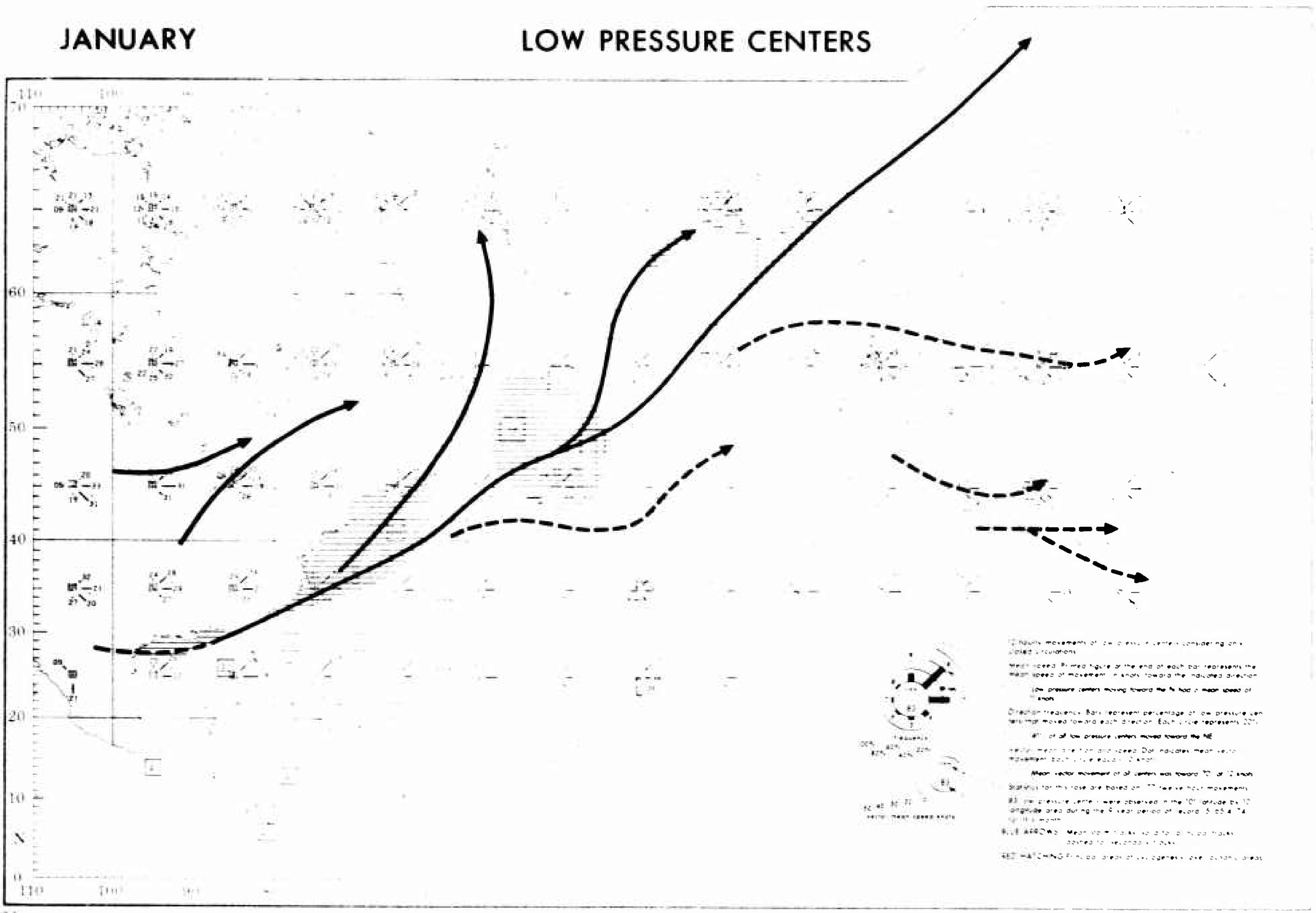
JANUARY

INSUFFICIENT DATA

INSUFFICIENT DATA

JANUARY

LOW PRESSURE CENTERS

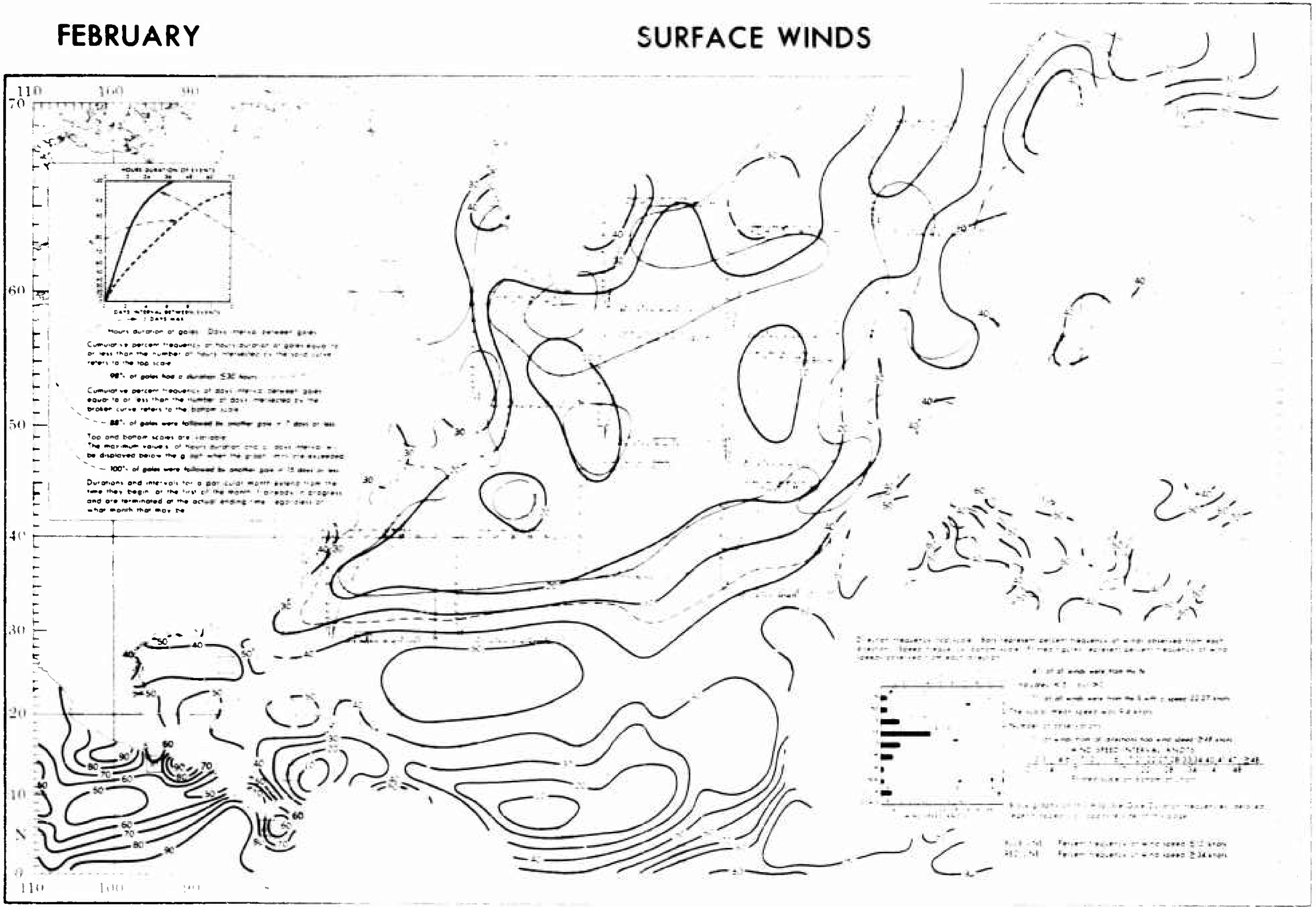


TROPICAL CYCLONE

JANUARY

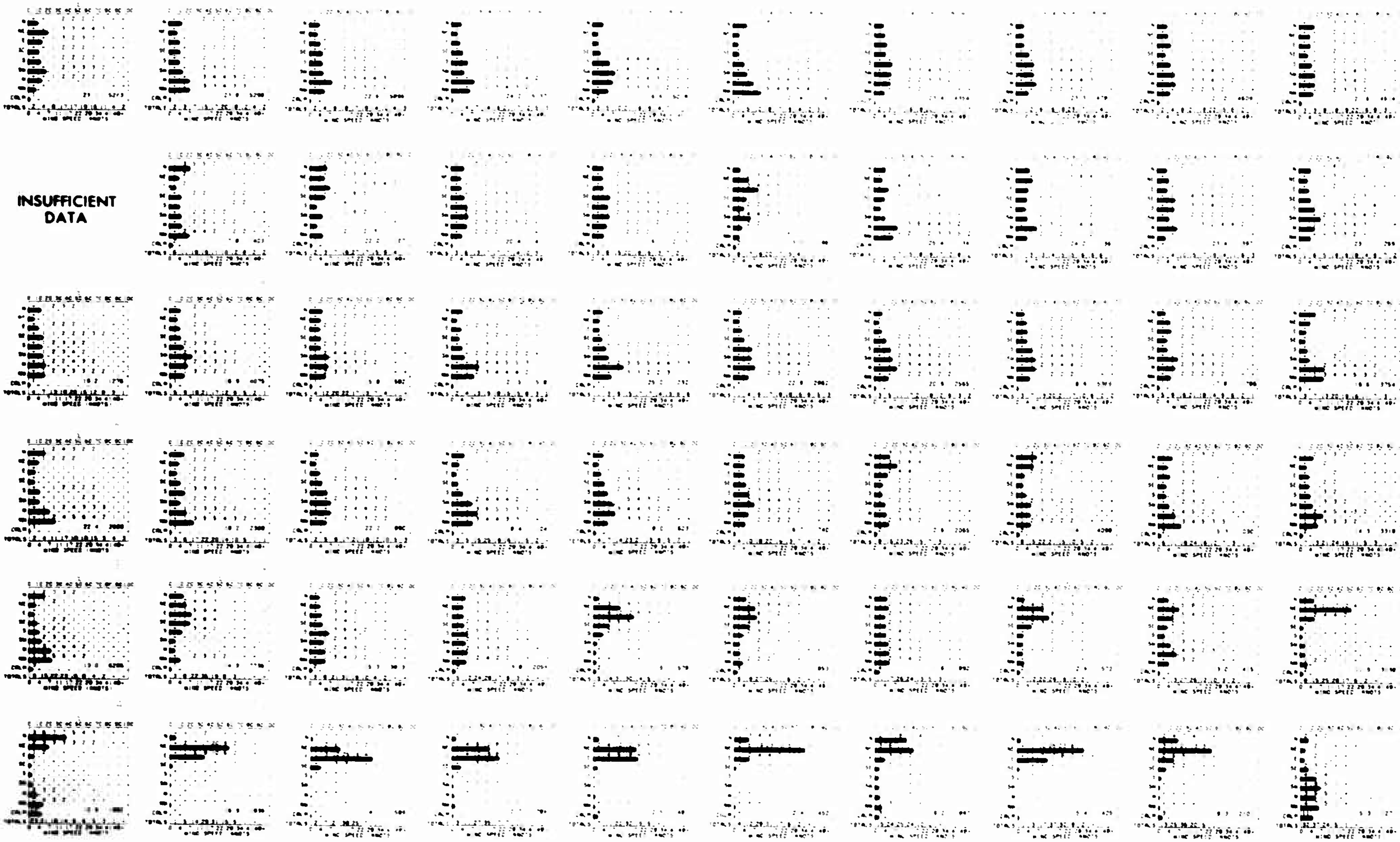
FEBRUARY

SURFACE WINDS

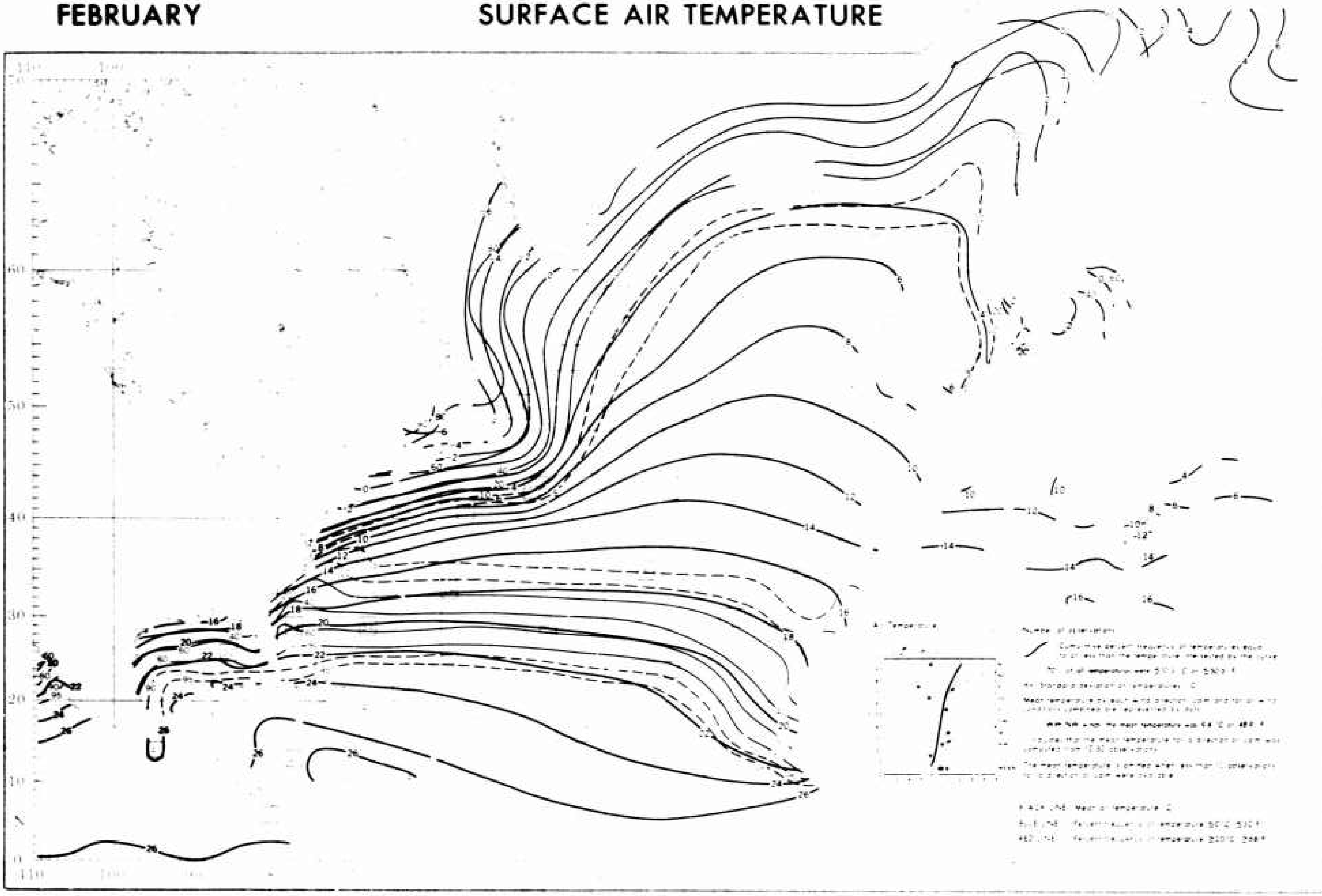


WIND DIRECTION AND SPEED

FEBRUARY

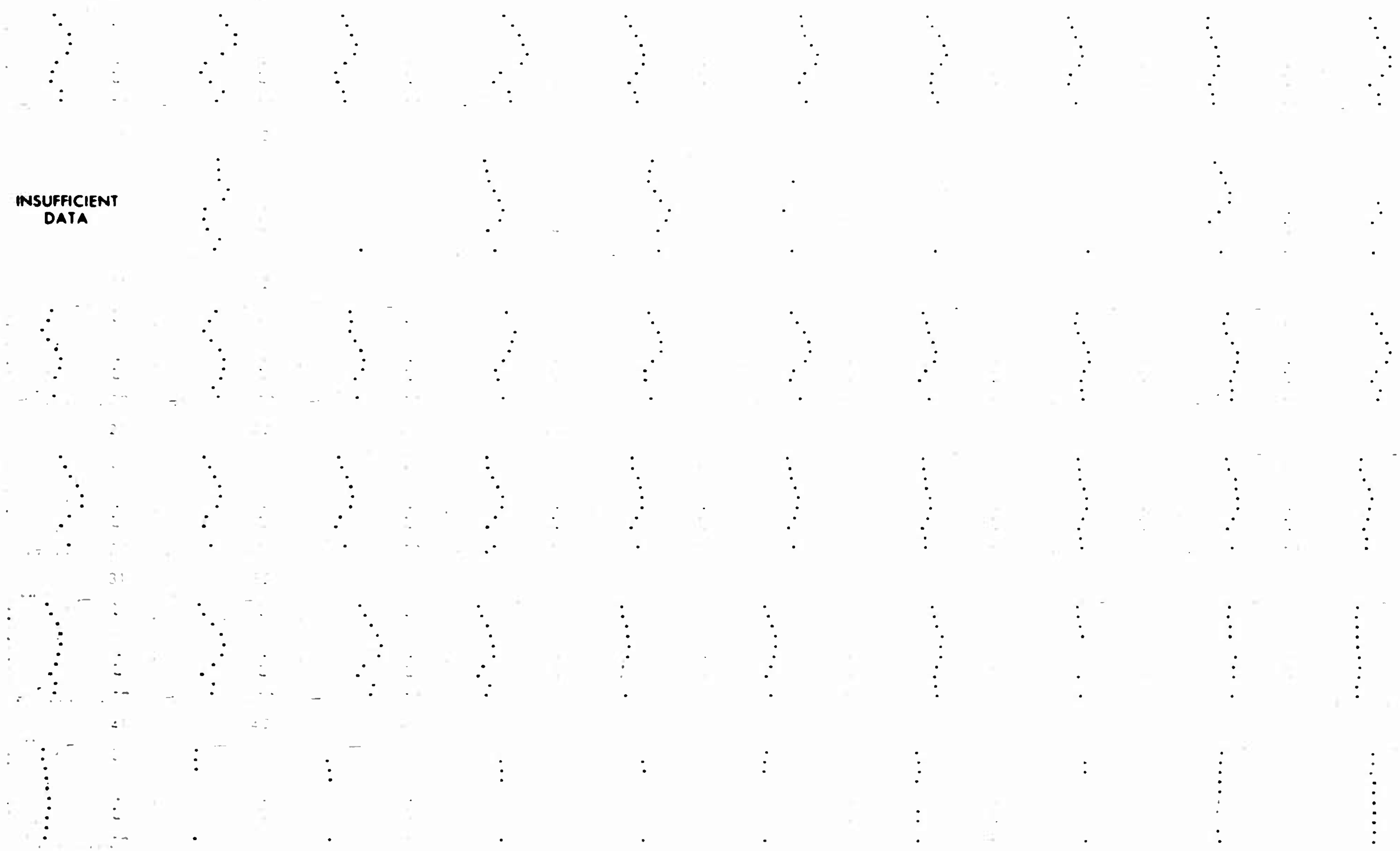


FEBRUARY SURFACE AIR TEMPERATURE

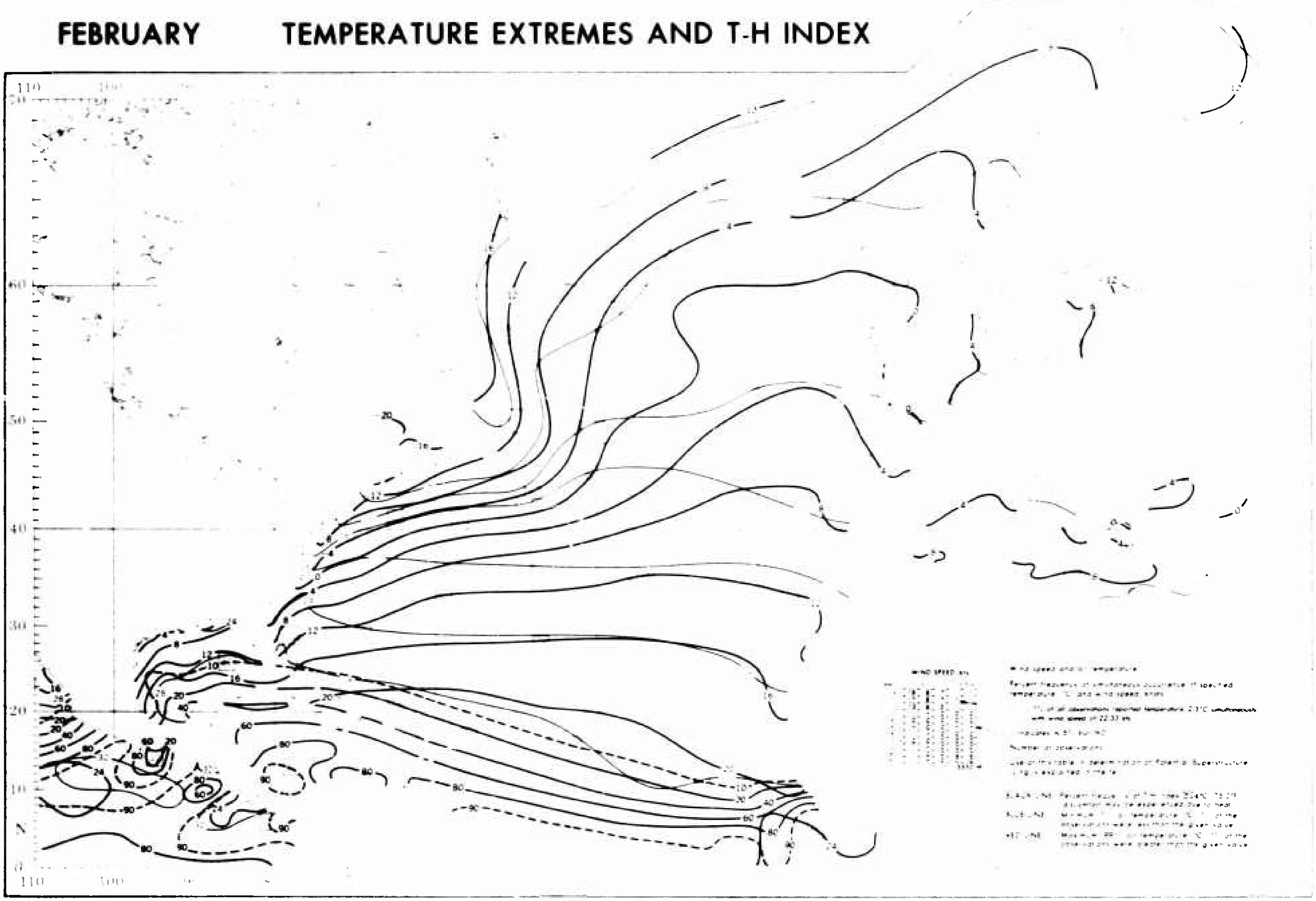


SURFACE AIR TEMPERATURE

FEBRUARY



FEBRUARY TEMPERATURE EXTREMES AND T-H INDEX

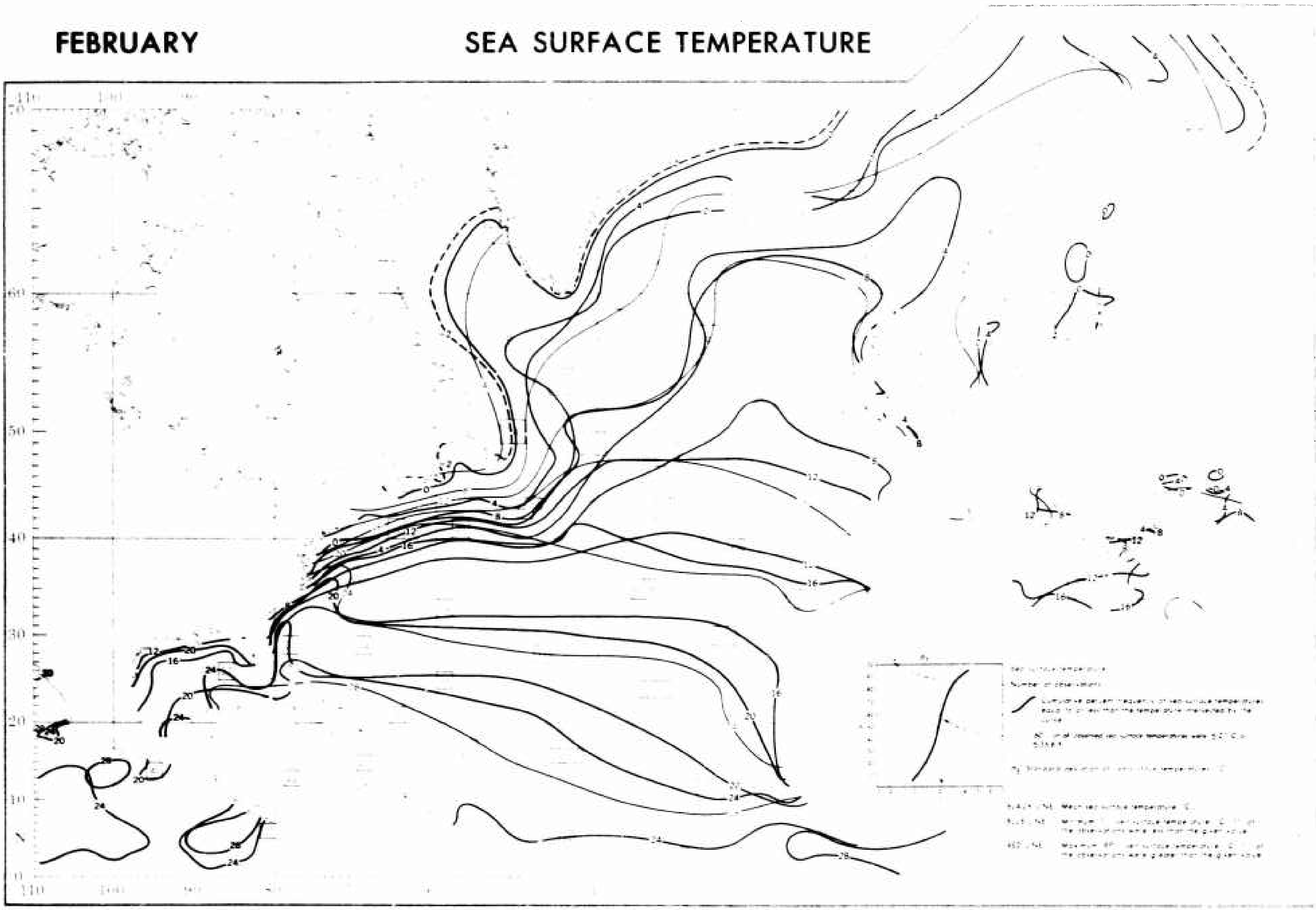


WIND SPEED AND AIR TEMPERATURE

FEBRUARY

INSUFFICIENT DATA

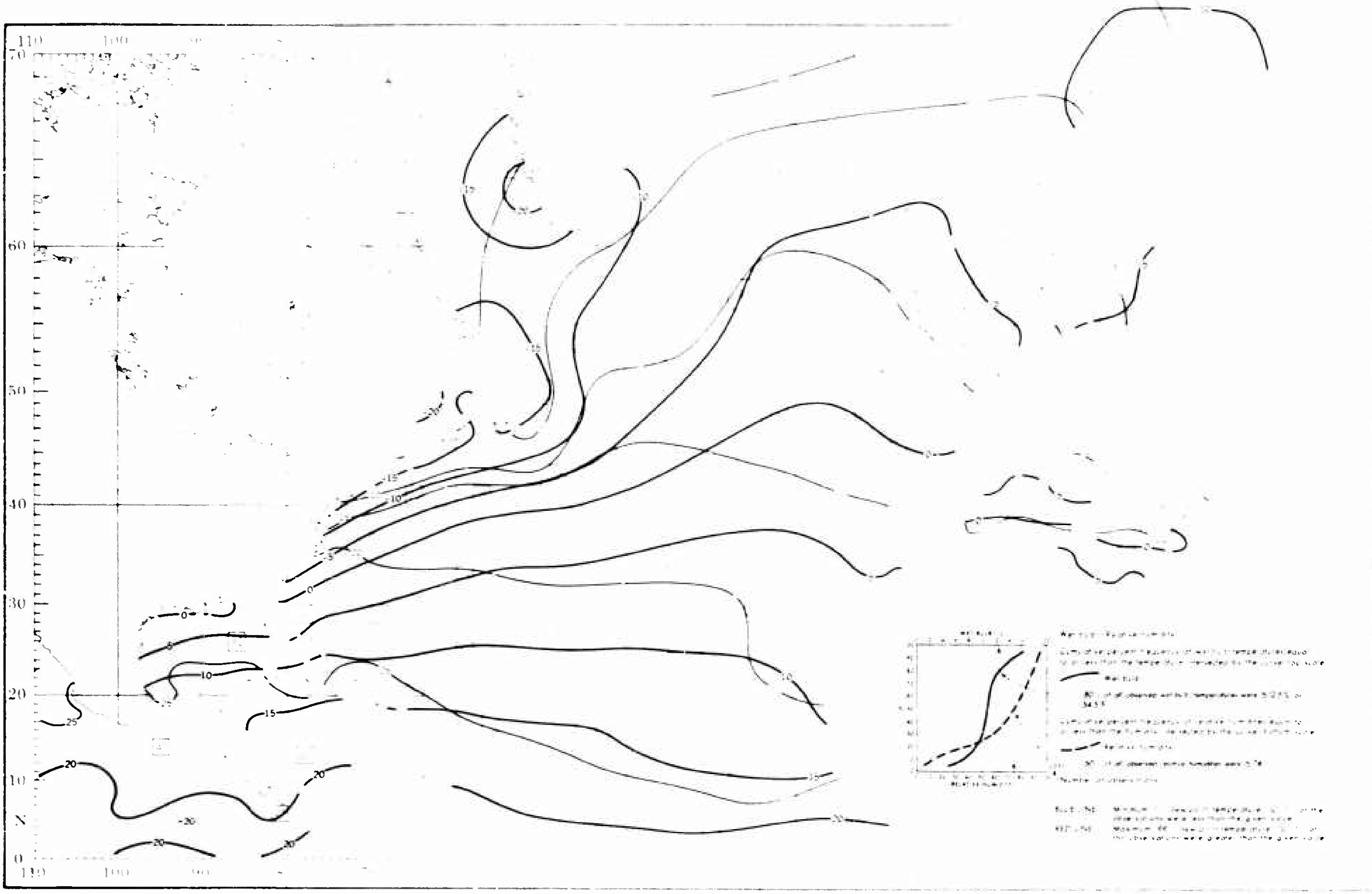
FEBRUARY SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE

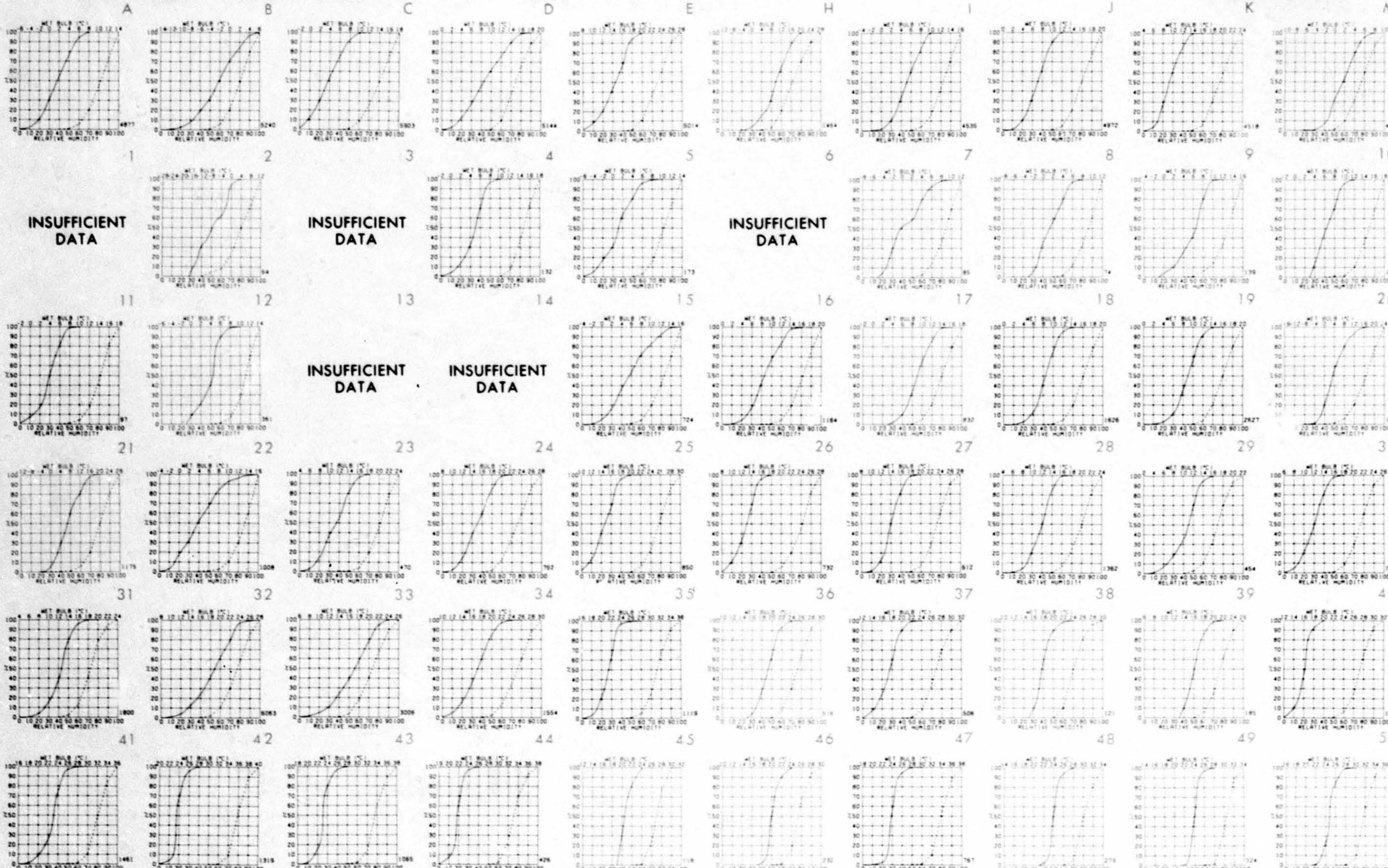
FEBRUARY

FEBRUARY HUMIDITY



WET BULB AND RELATIVE HUMIDITY

FEBRUARY



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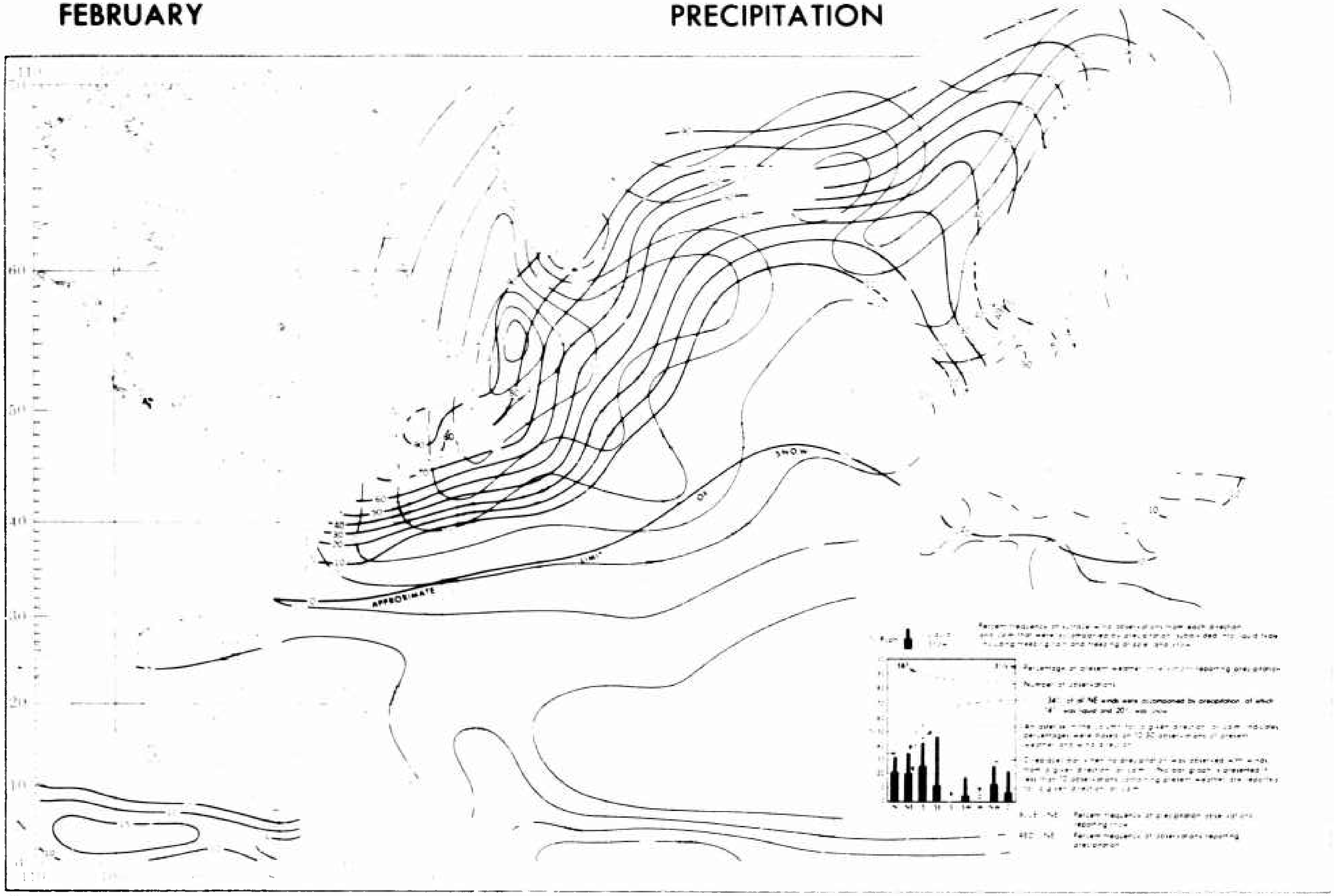
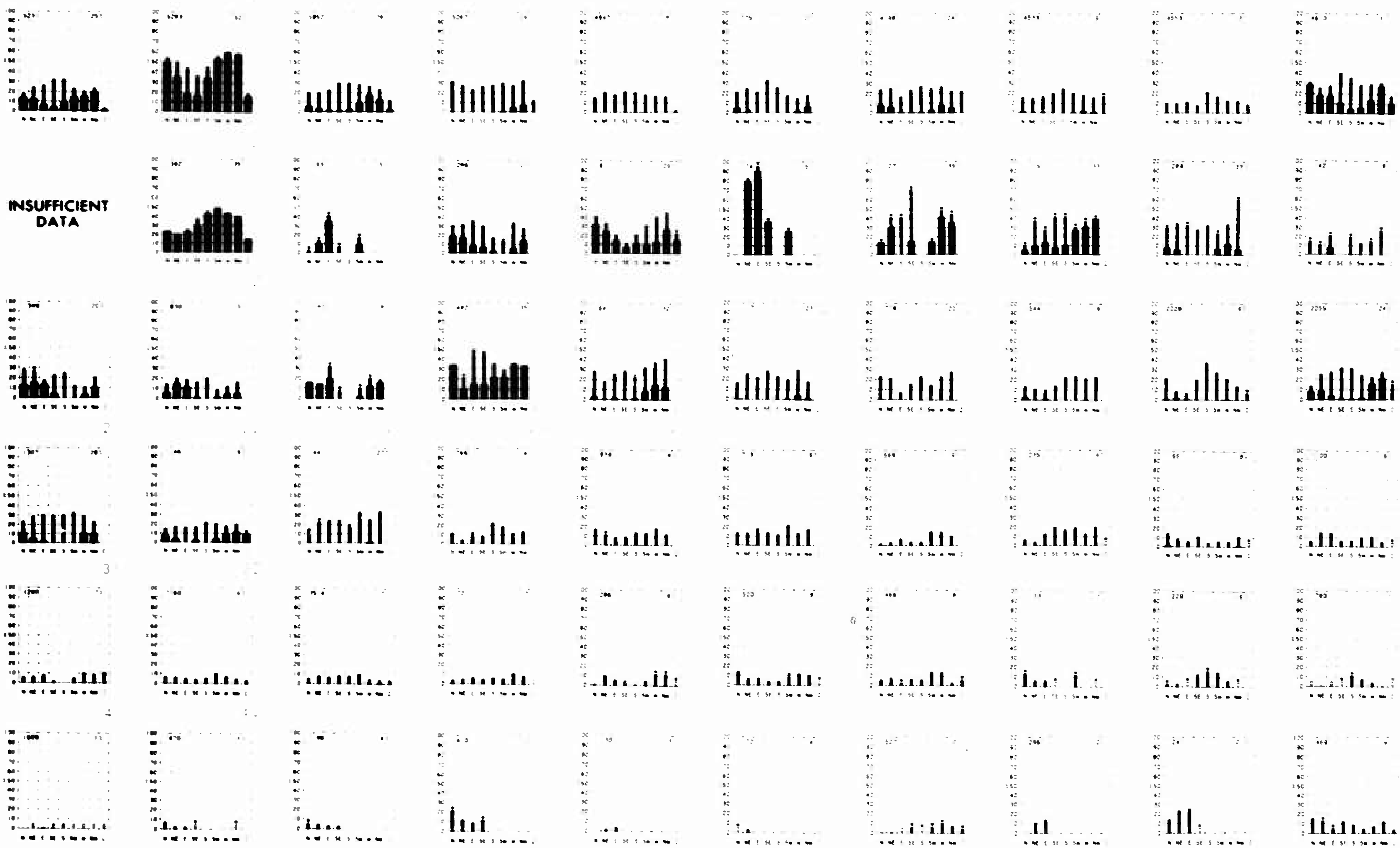
The isopleth analyses (opposite page) are based on all available data subjectively adjusted where bias was evident

FEBRUARY

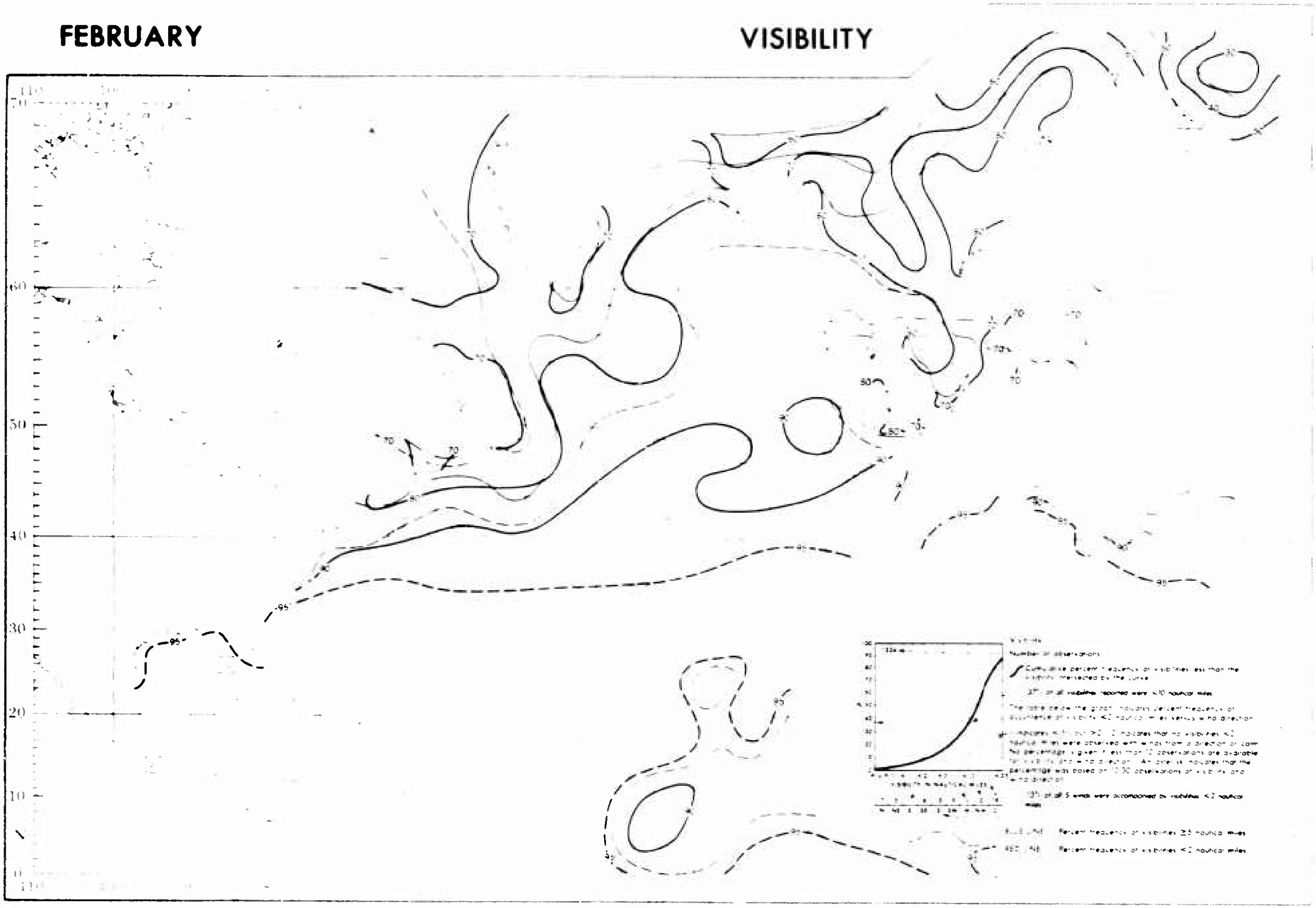
PRECIPITATION



PRECIPITATION FEBRUARY

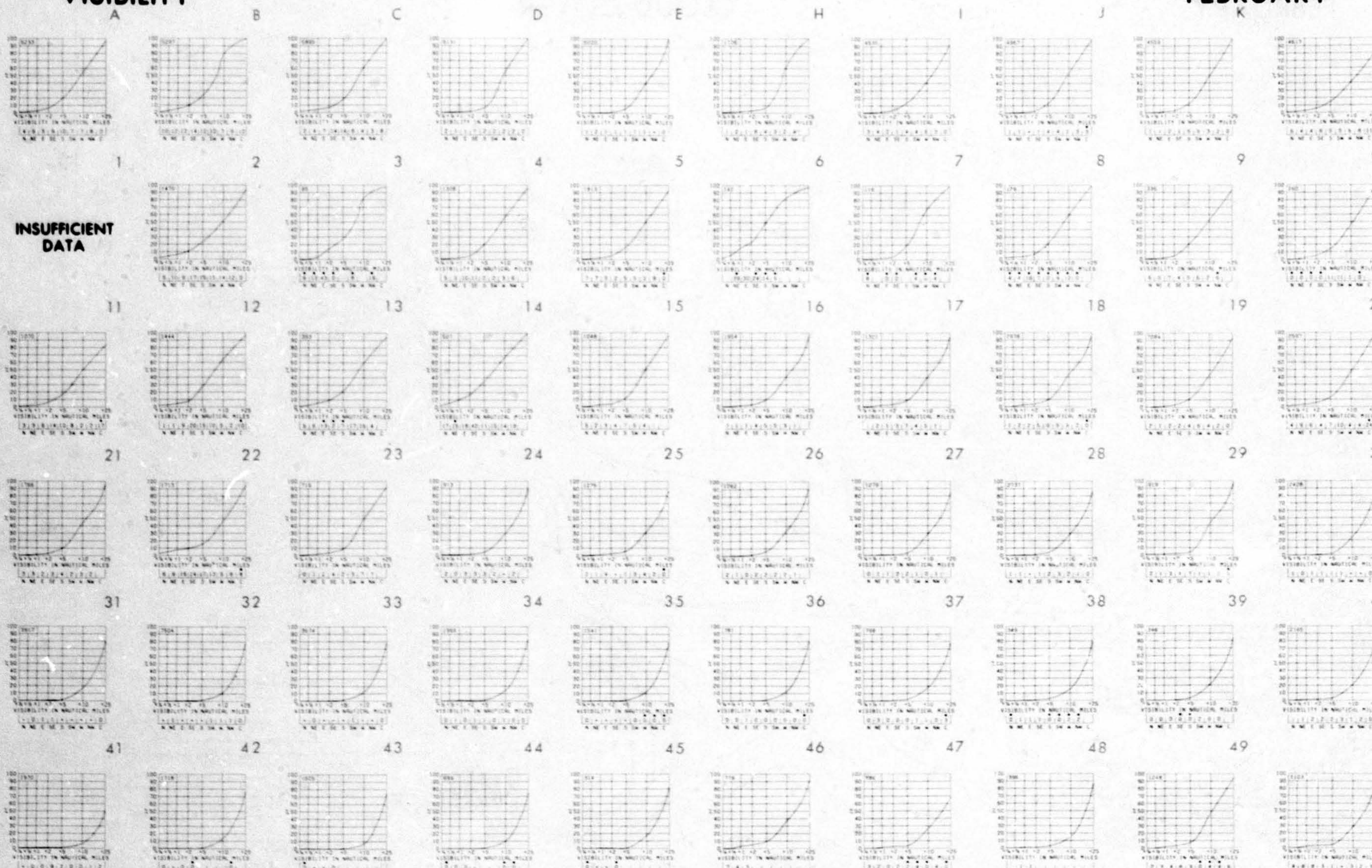


FEBRUARY VISIBILITY



VISIBILITY

FEBRUARY



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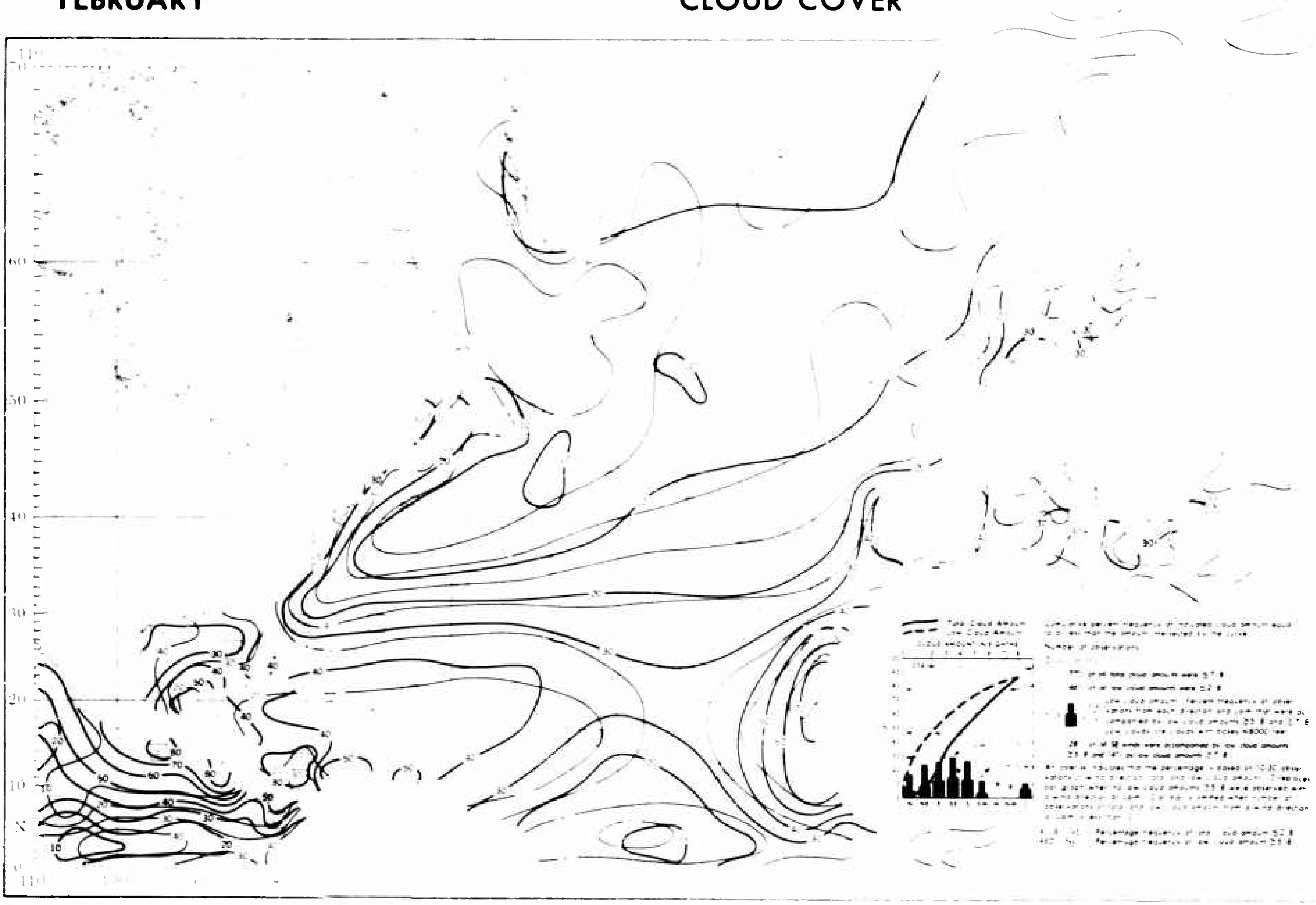
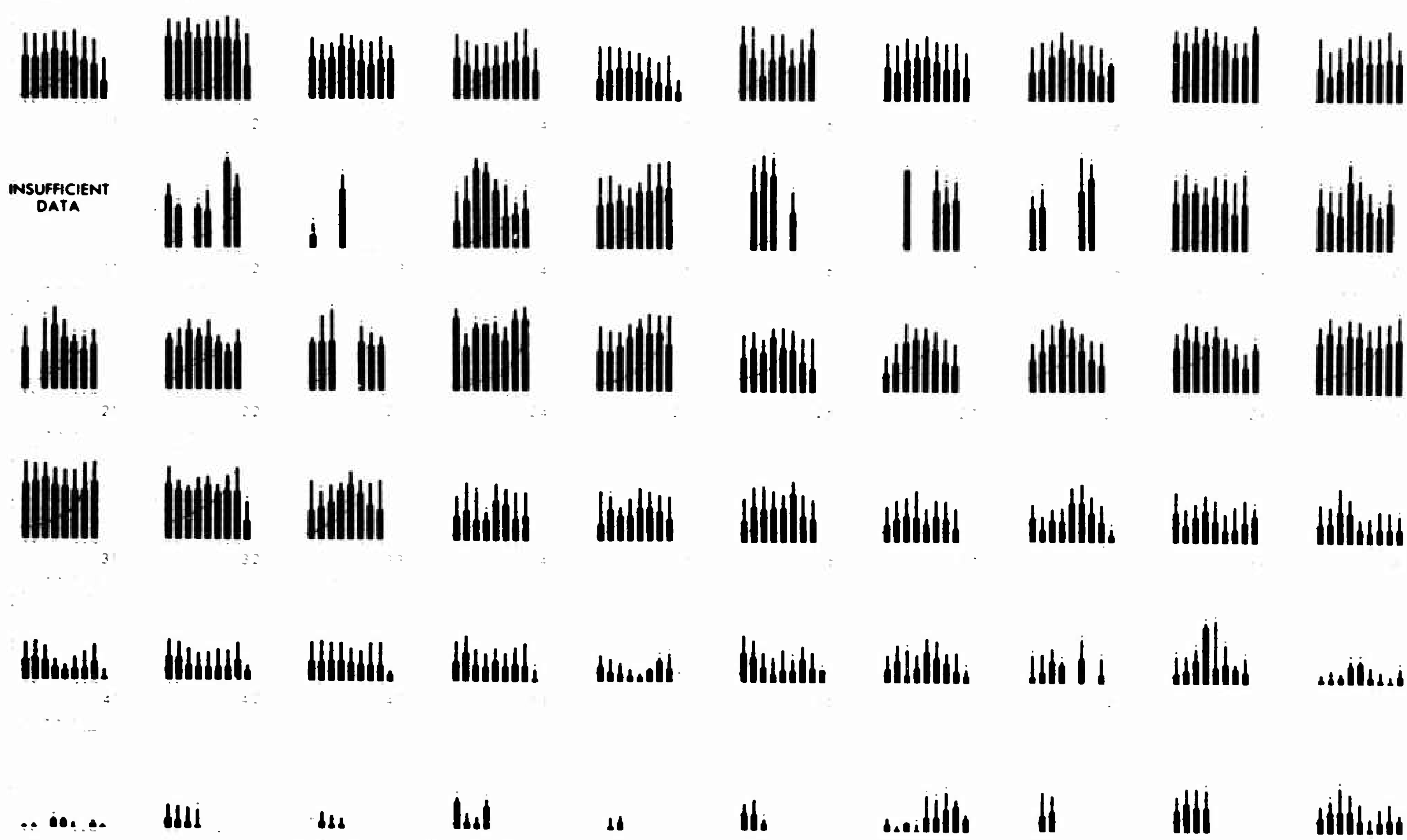
FEBRUARY CLOUD COVER



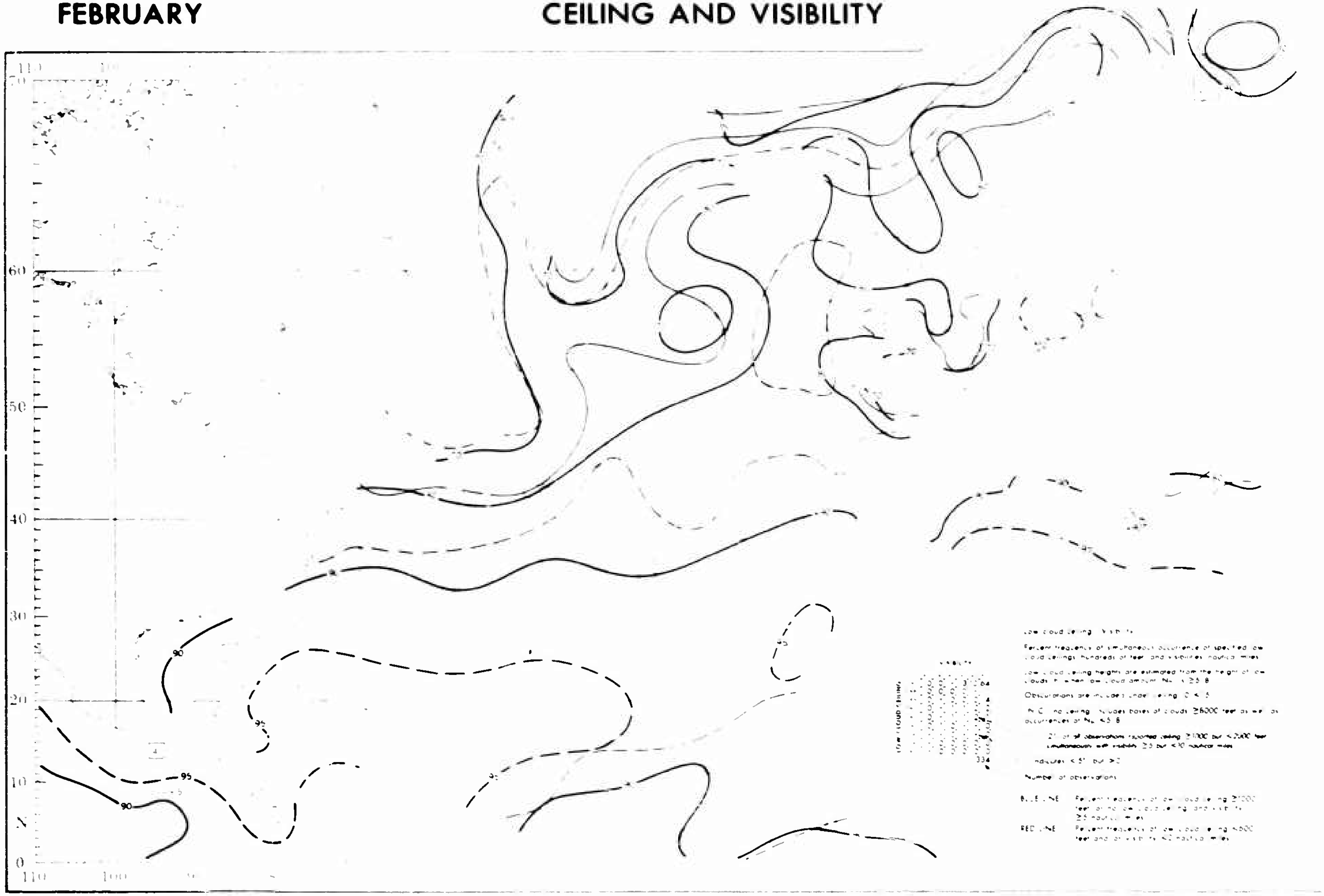
CLOUD COVER

FEBRUARY



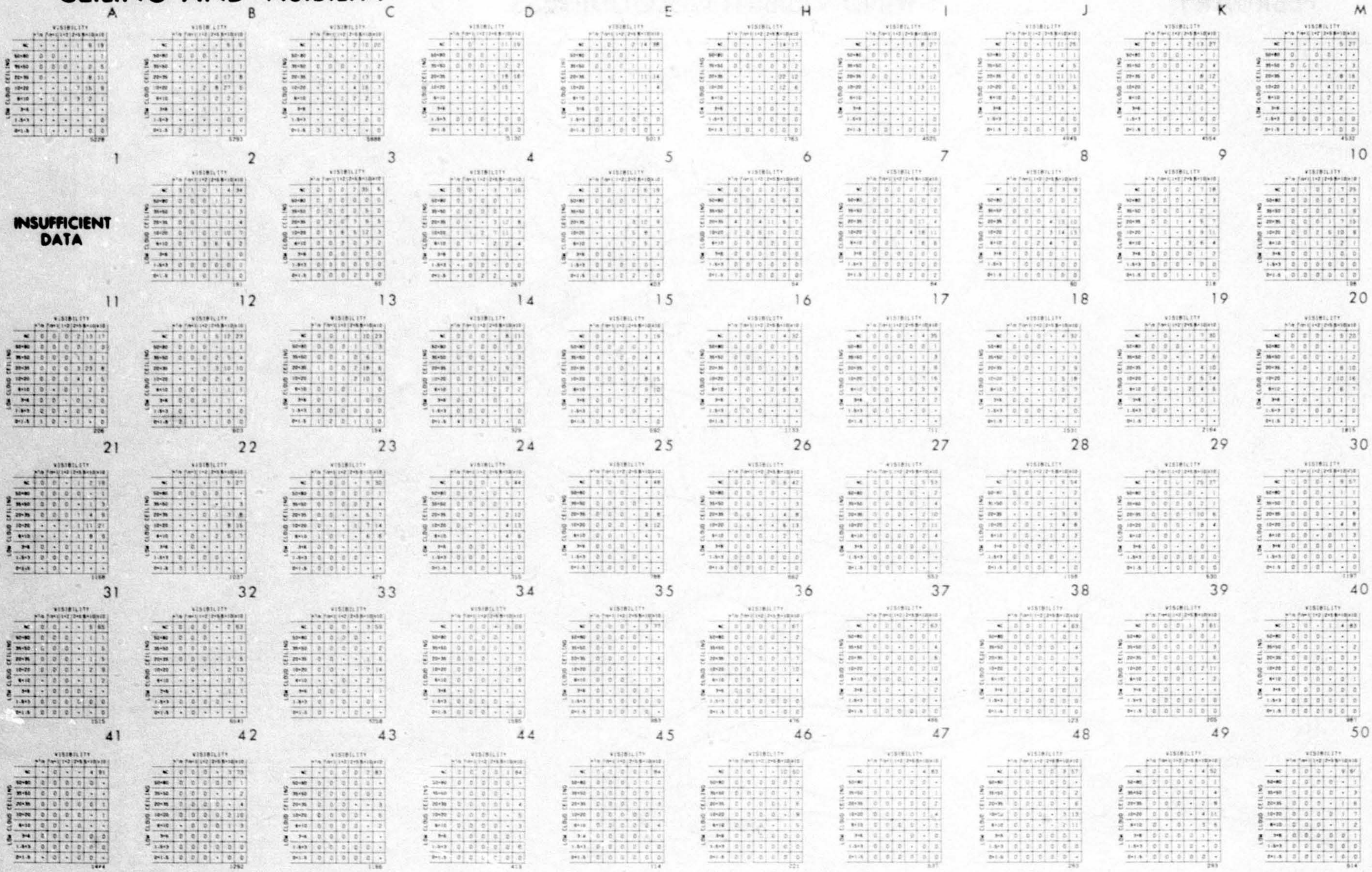
FEBRUARY

CEILING AND VISIBILITY



CEILING AND VISIBILITY

FEBRUARY



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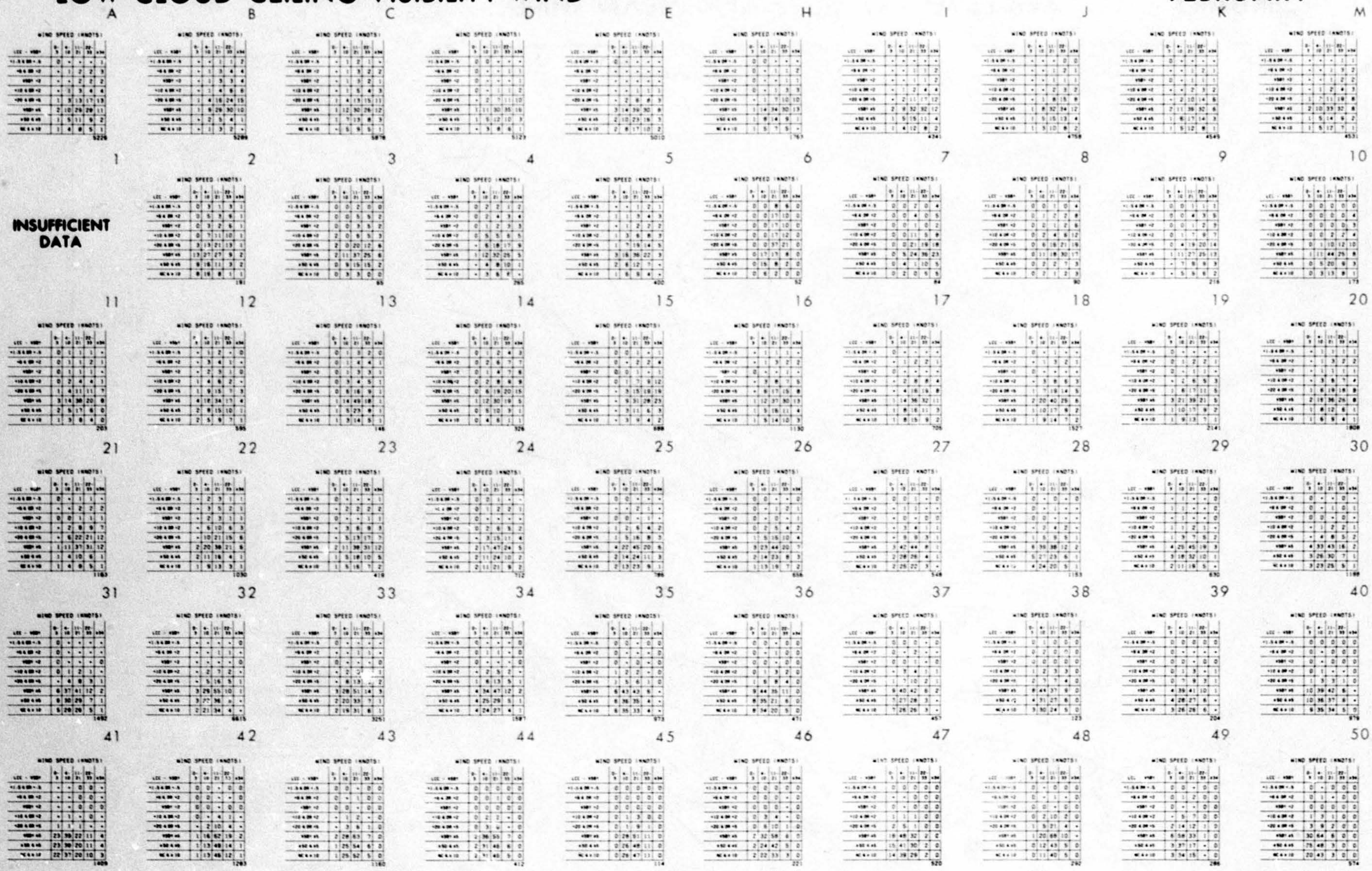
FEBRUARY

WIND-VISIBILITY-CLOUDINESS

LOW CLOUD CEILING-VISIBILITY-WIND

FEBRUARY



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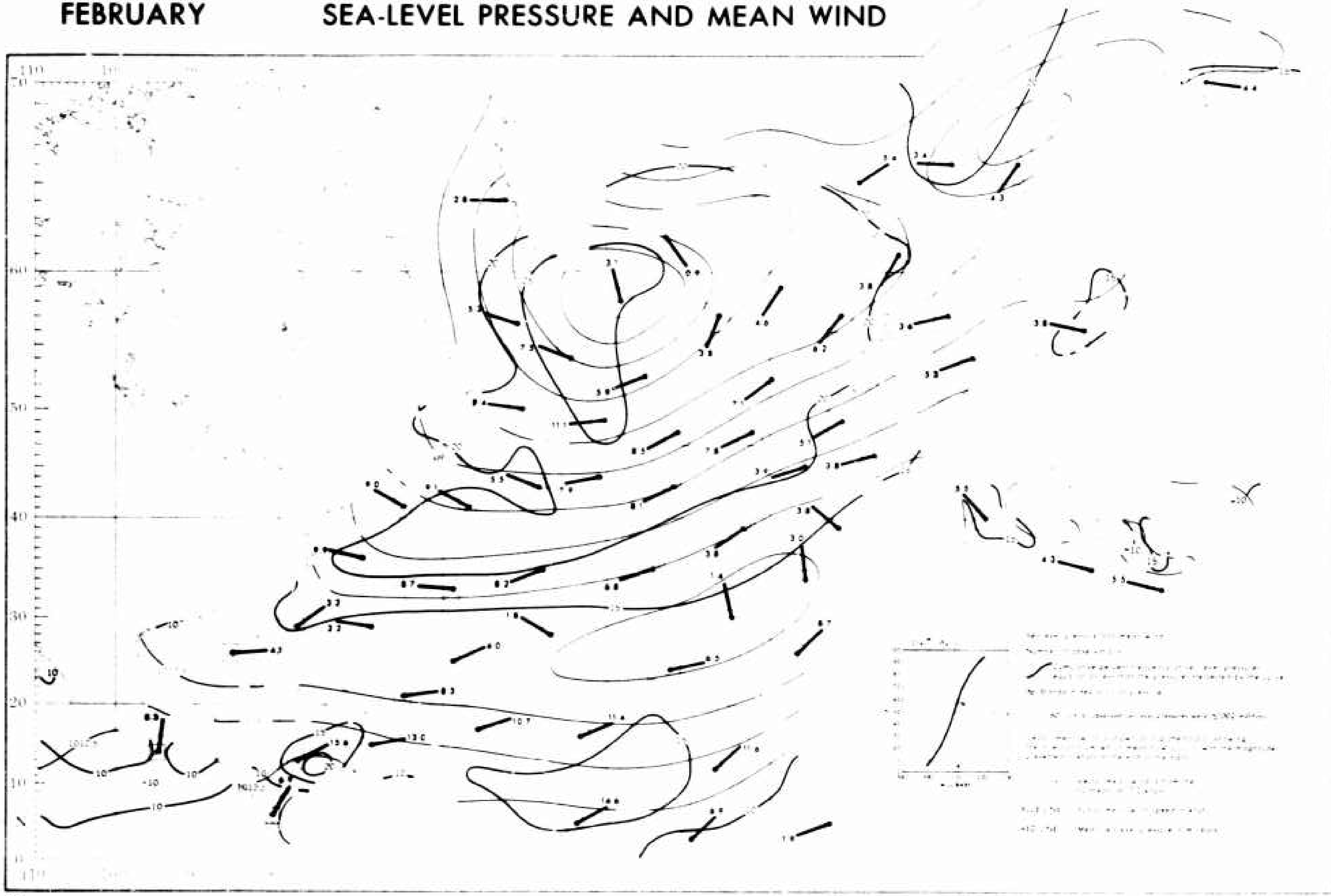
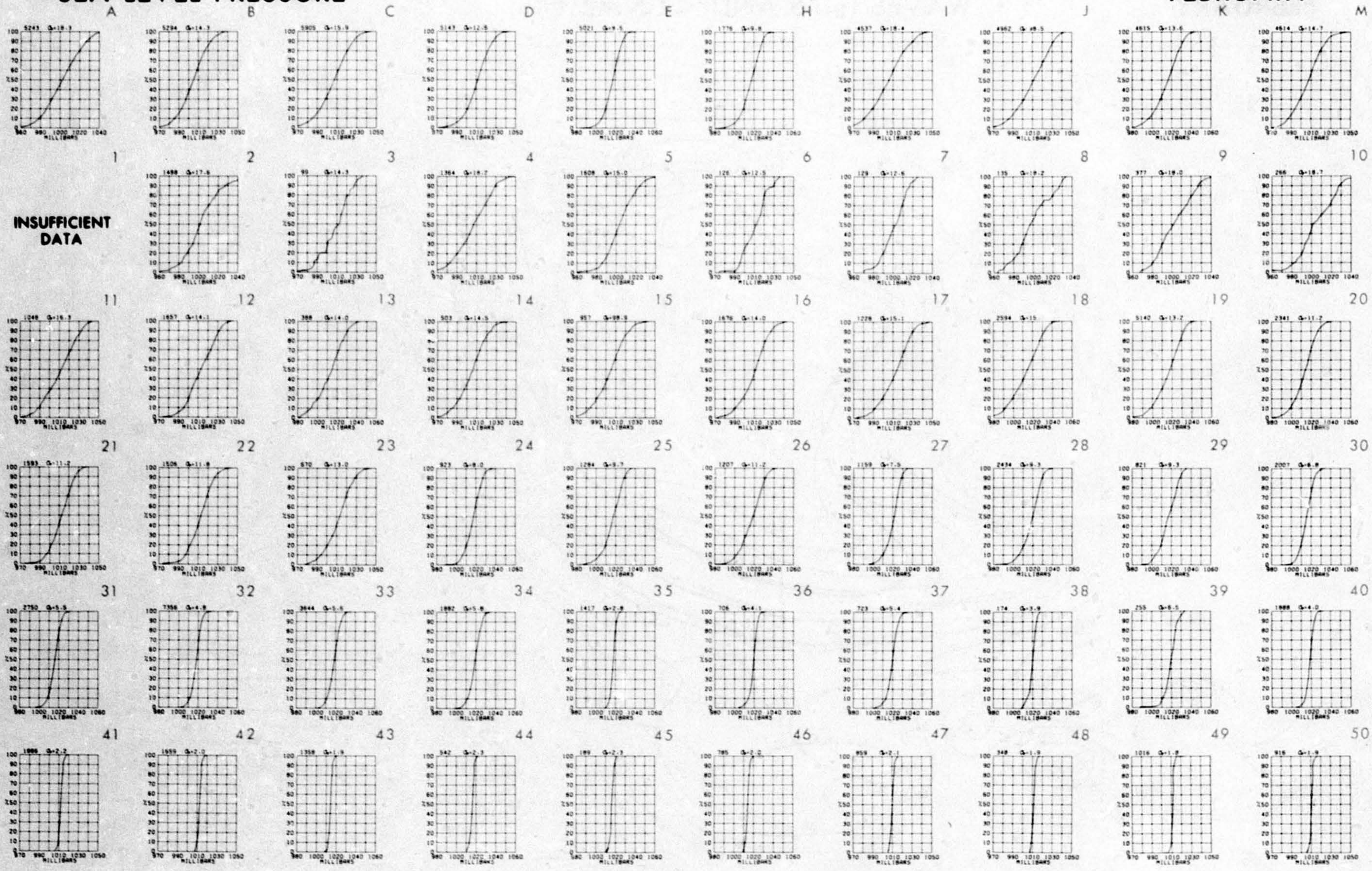
FEBRUARY SEA-LEVEL PRESSURE AND MEAN WIND



SEA LEVEL PRESSURE

FEBRUARY



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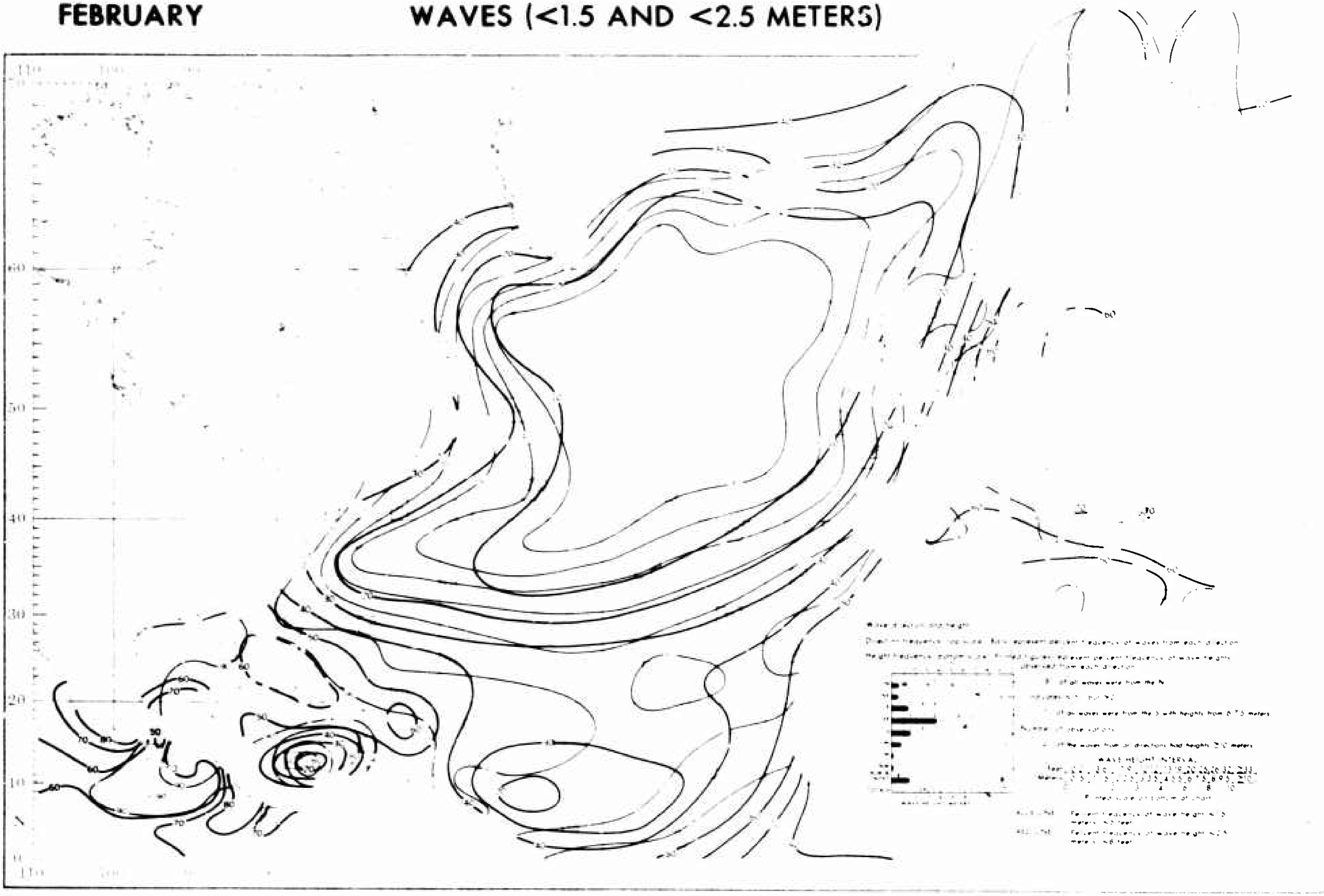
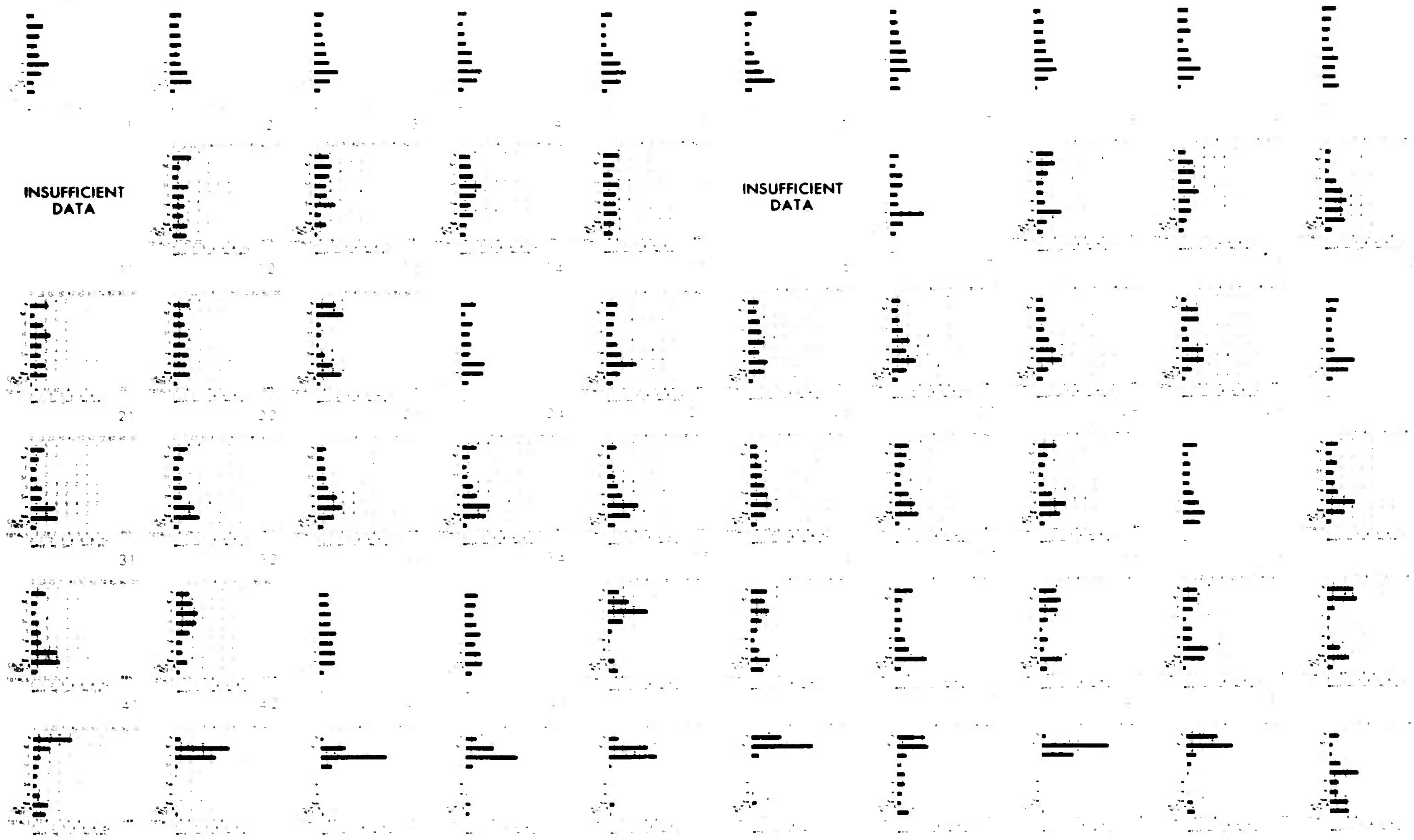
FEBRUARY WAVES (<1.5 AND <2.5 METERS)

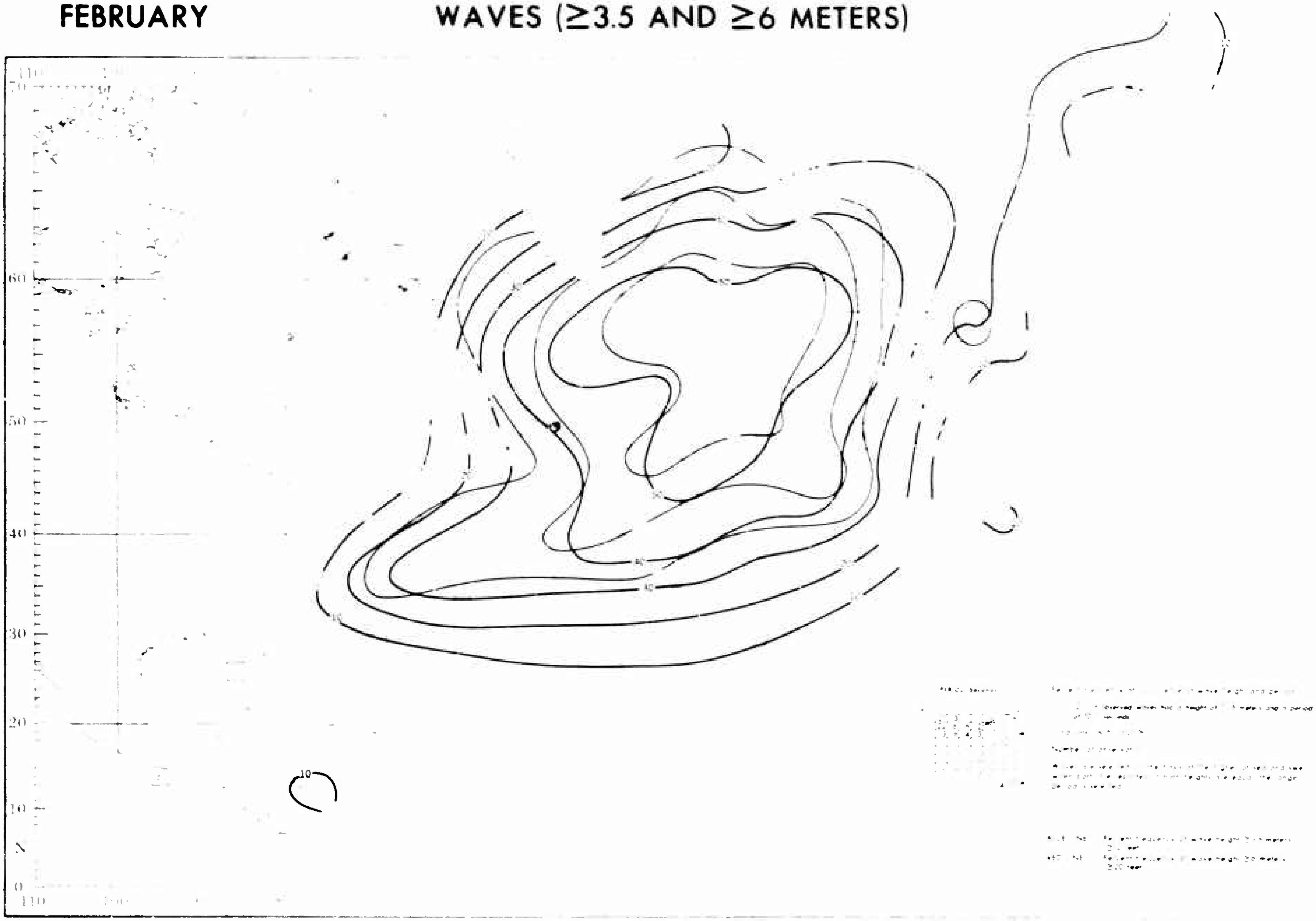


WAVE DIRECTION AND HEIGHT

FEBRUARY

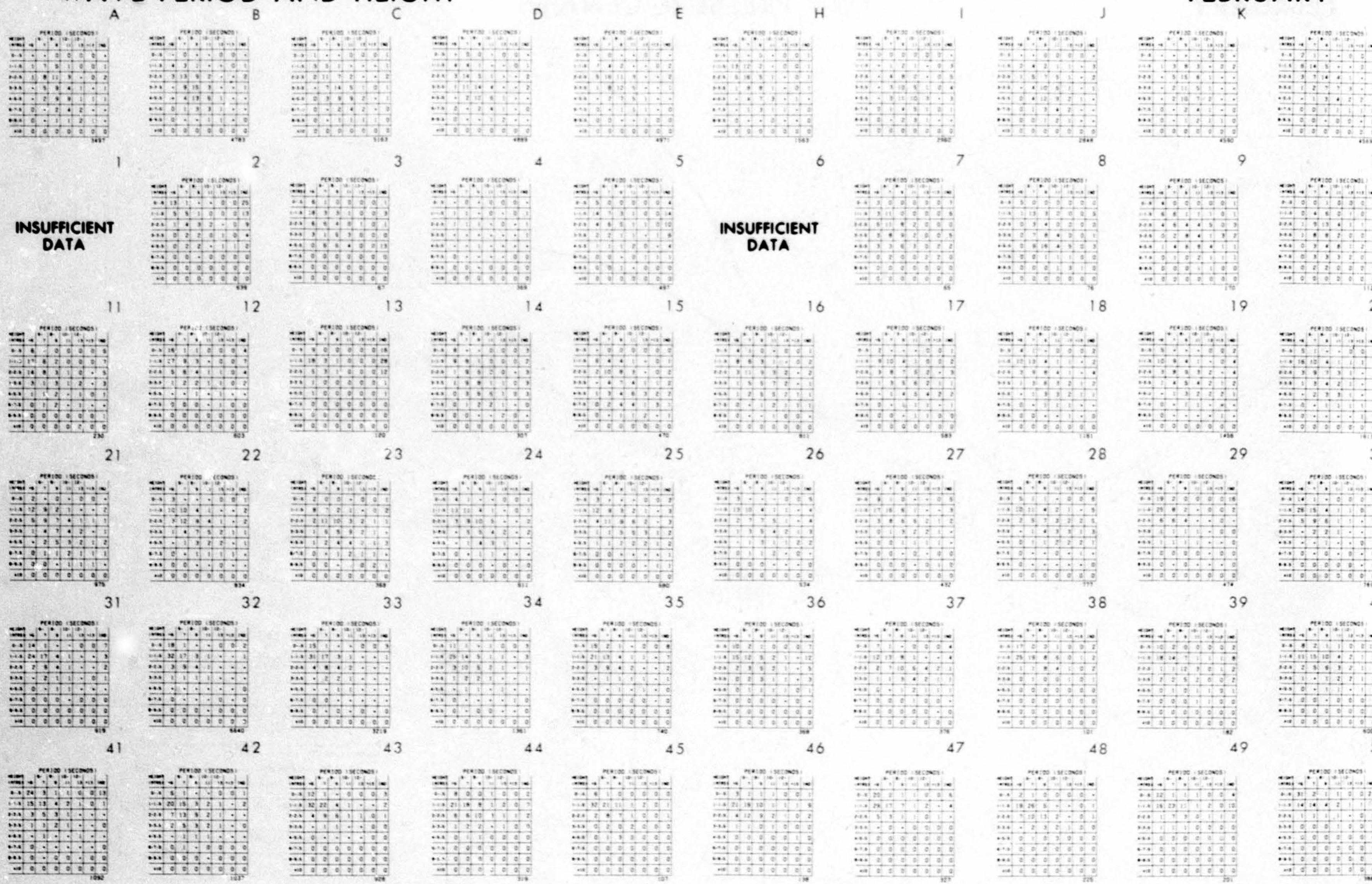


FEBRUARY WAVES (≥3.5 AND ≥6 METERS)



WAVE PERIOD AND HEIGHT

FEBRUARY



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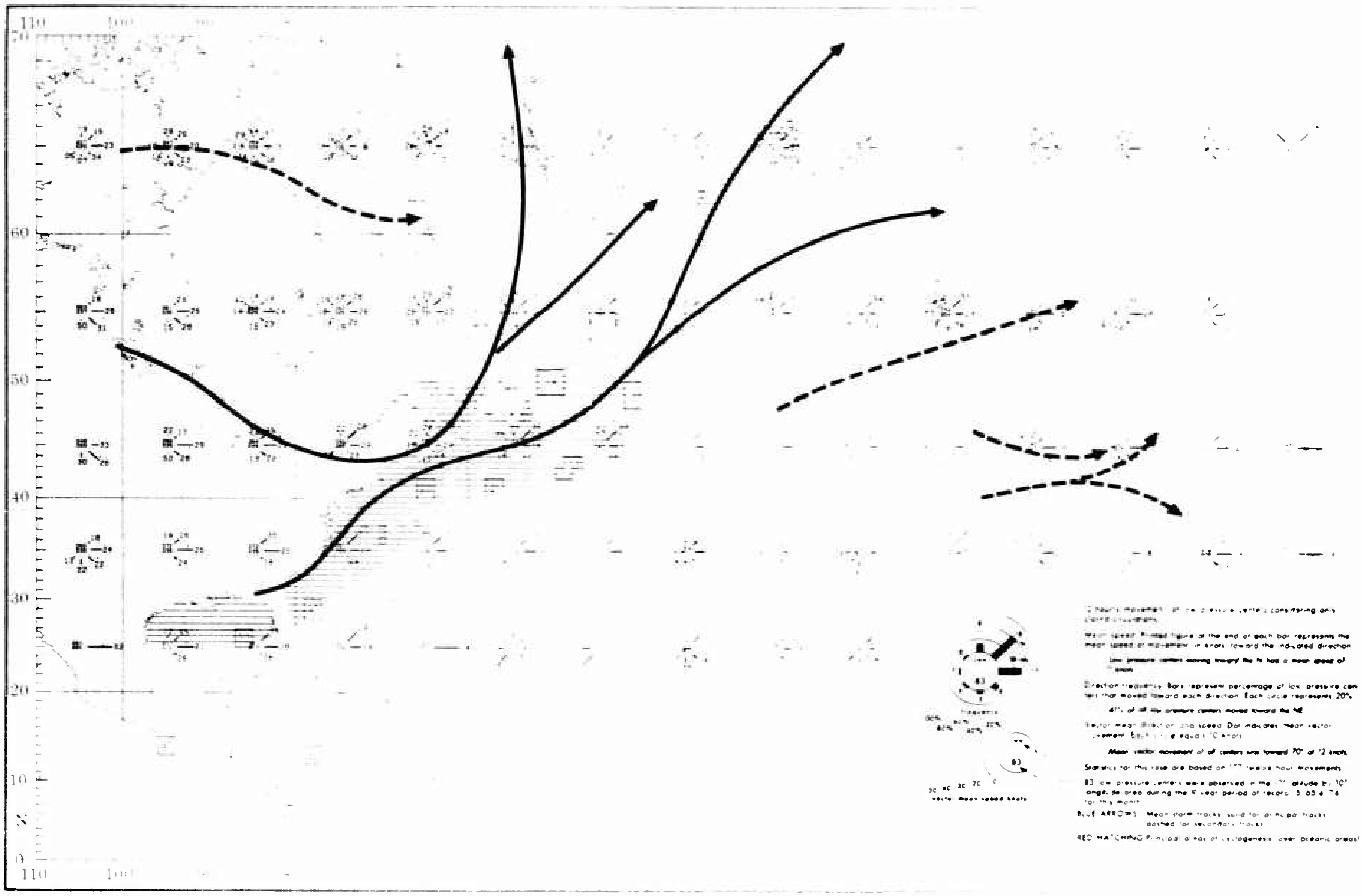
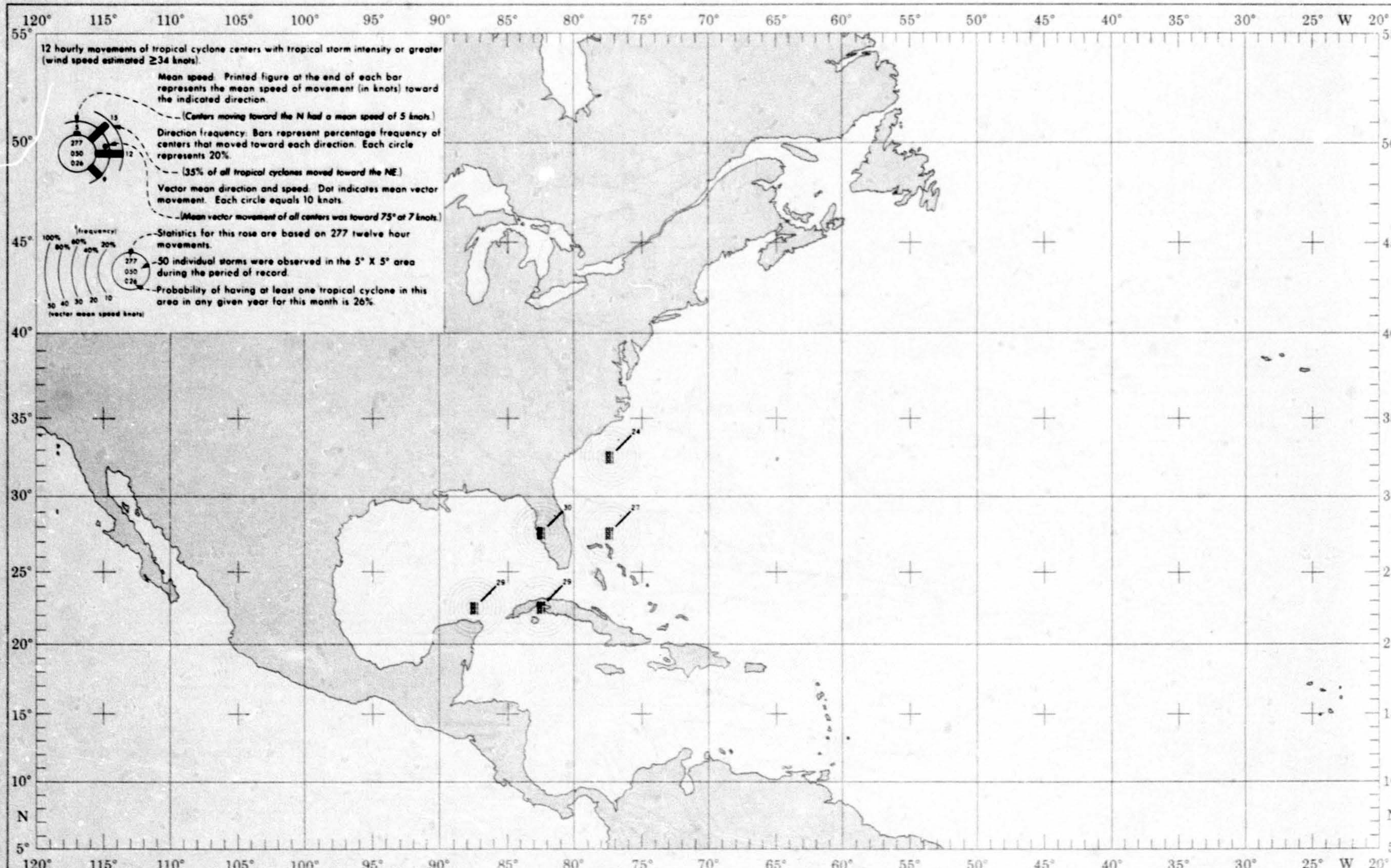
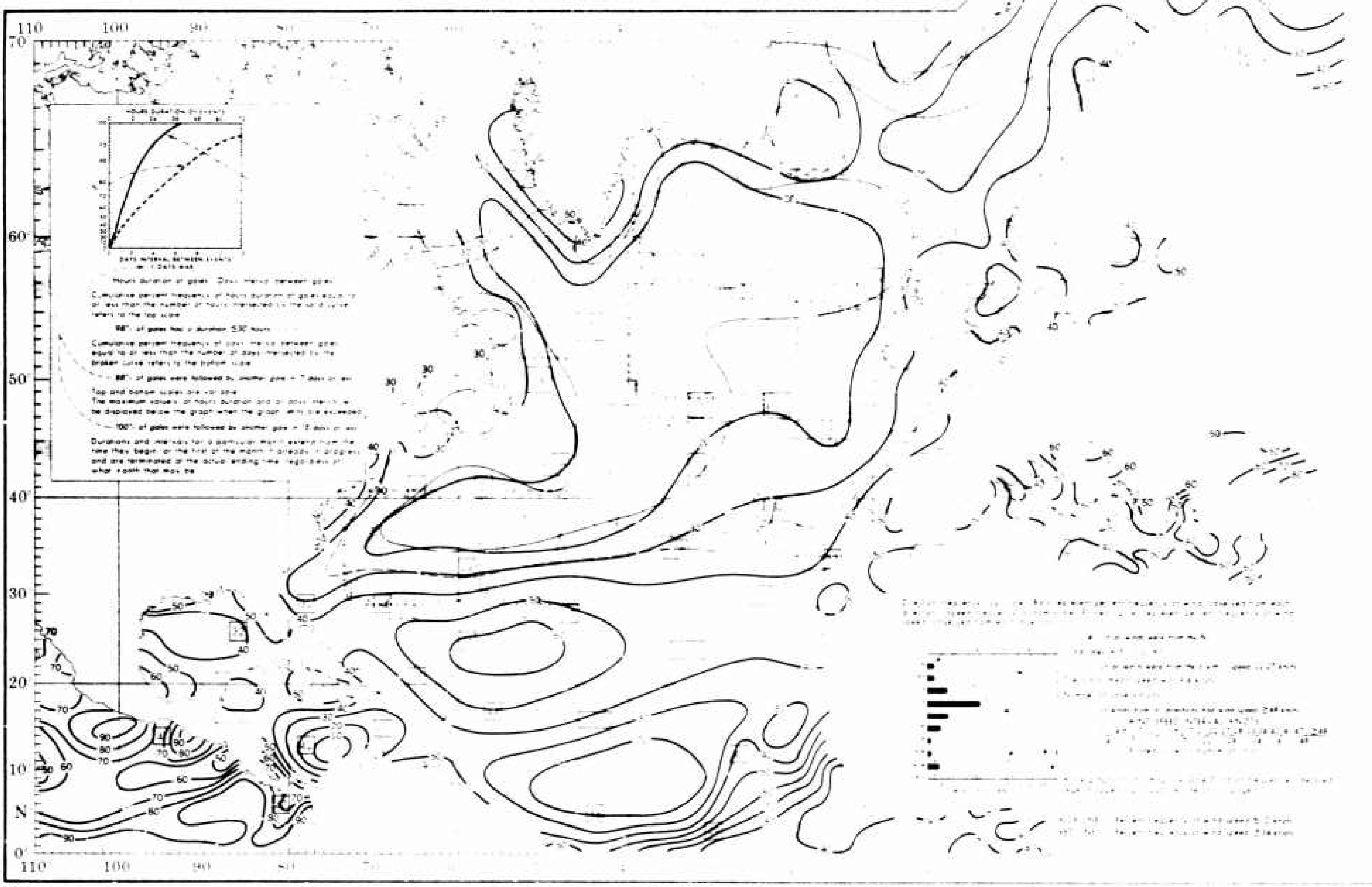
FEBRUARY LOW PRESSURE CENTERS




12 hourly movements of tropical cyclone centers with tropical storm intensity or greater (wind speed estimated ≥34 knots).
Mean speed: Printed figure at the end of each bar represents the mean speed of movement (in knots) toward the indicated direction.
(Centers moving toward the N had a mean speed of 5 knots.)
Direction frequency: Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.
(35% of all tropical cyclones moved toward the NE.)
Vector mean direction and speed: Dot indicates mean vector movement. Each circle equals 10 knots.
(Mean vector movement of all centers was toward 75° at 7 knots.)
Statistics for this rose are based on 277 twelve hour movements.
50 individual storms were observed in the 5° X 5° area during the period of record.
Probability of having at least one tropical cyclone in this area in any given year for this month is 26%.
(frequency)
100% 80% 60% 40% 20%
50 40 30 20 10
(vector mean speed knots)
277
050
026
24
30
27
29
29
120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° W 20°
55° 50° 45° 40° 35° 30° 25° 20° 15° 10° N 5°

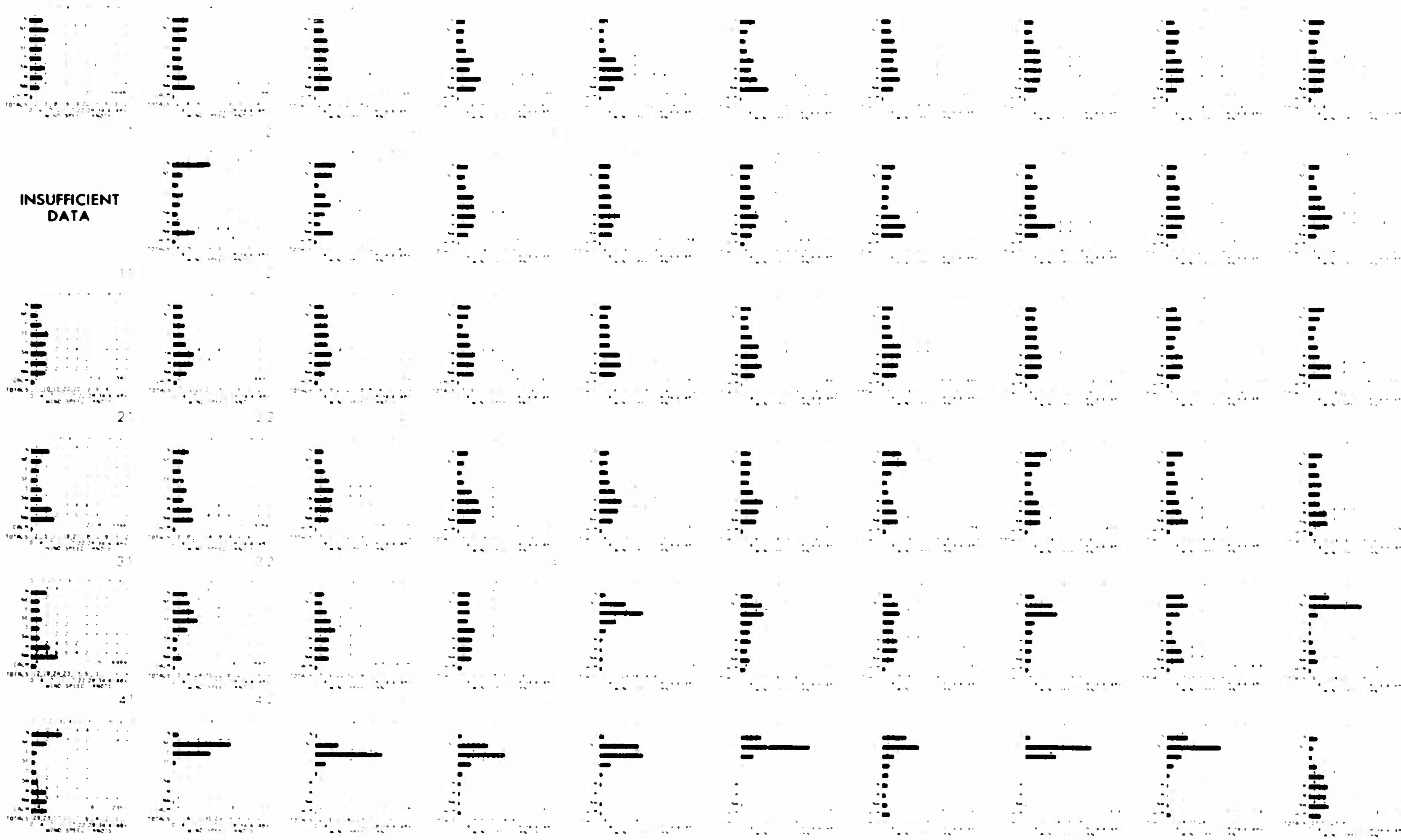
MARCH

SURFACE WINDS



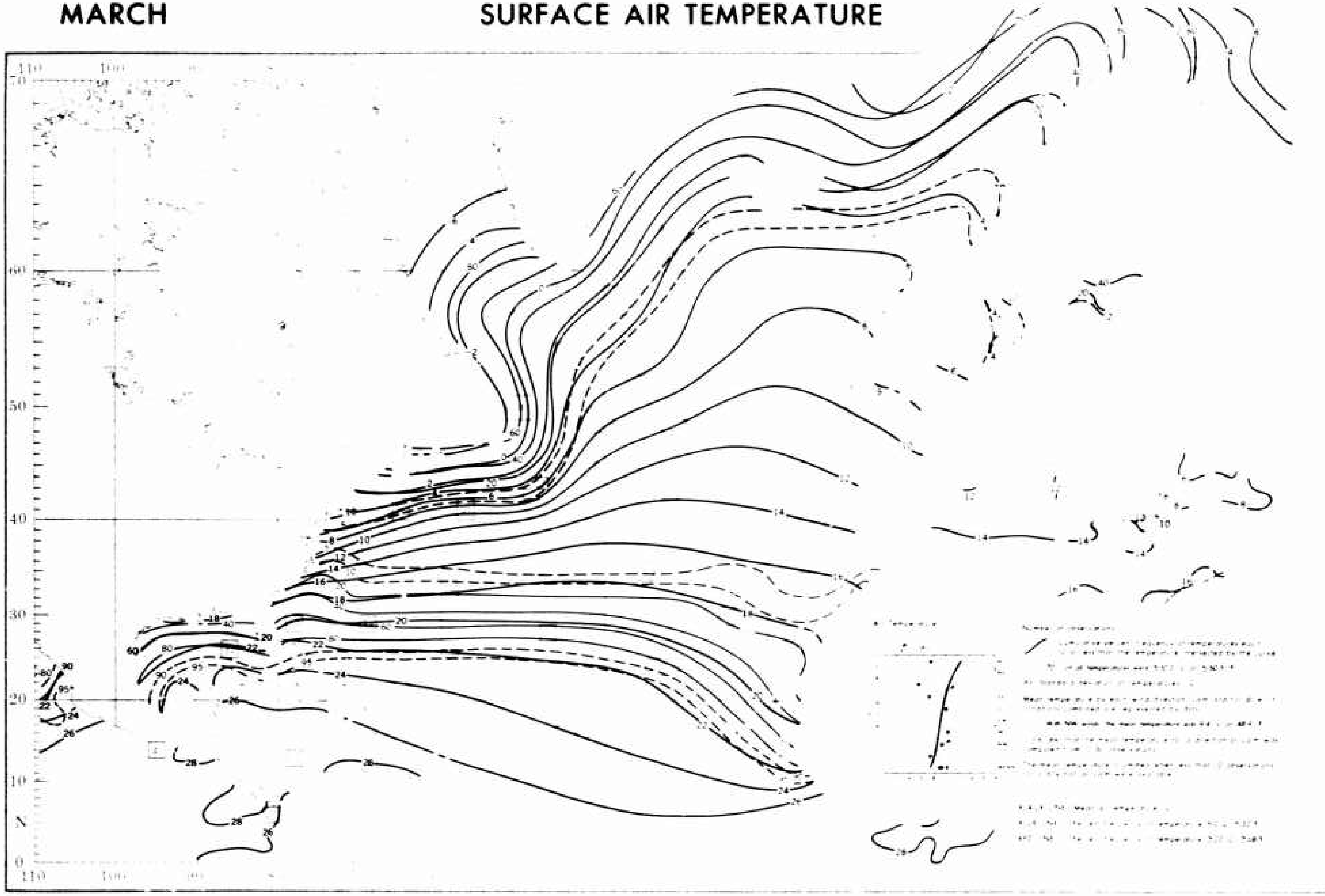
WIND DIRECTION AND SPEED

MARCH



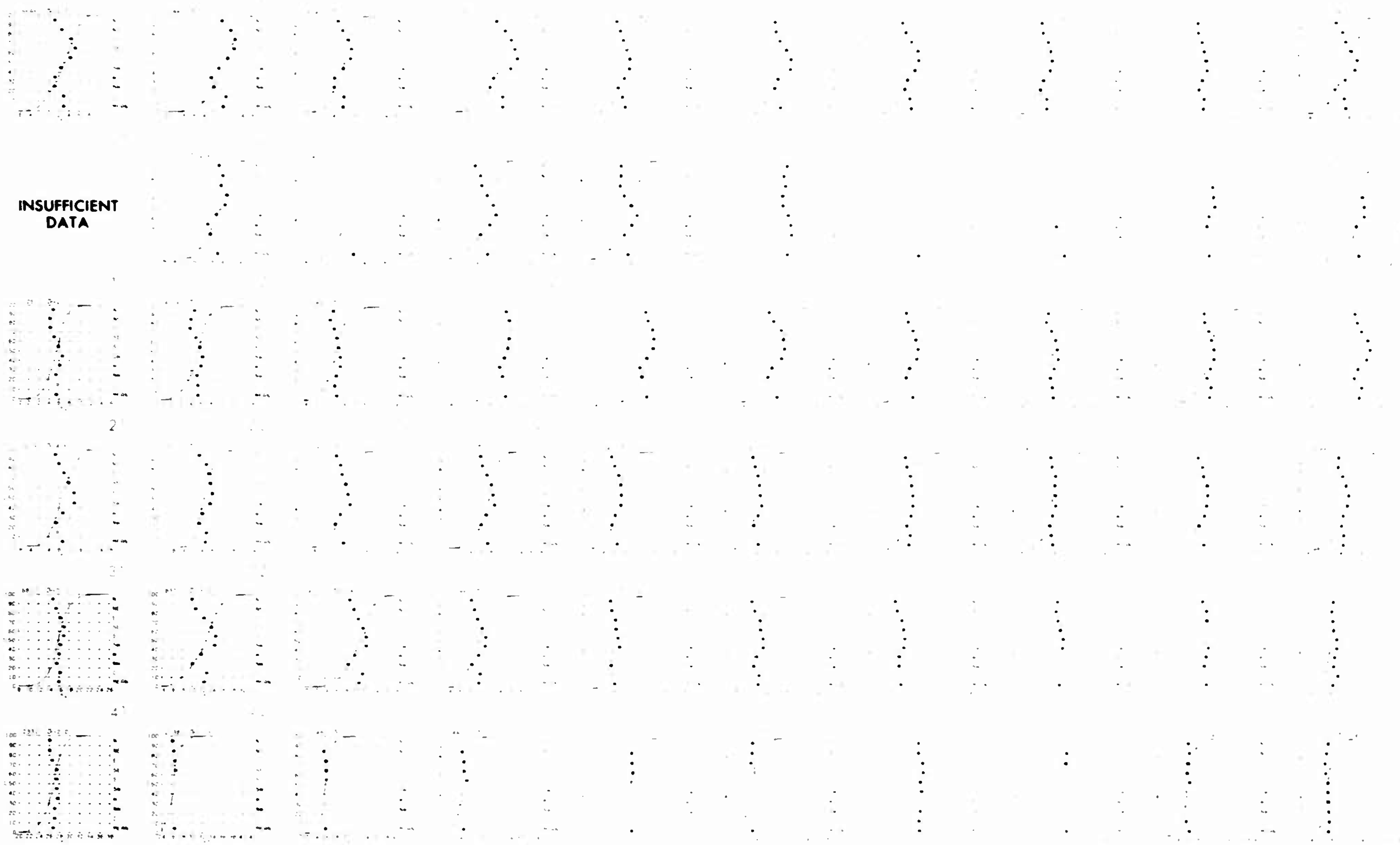
MARCH

SURFACE AIR TEMPERATURE

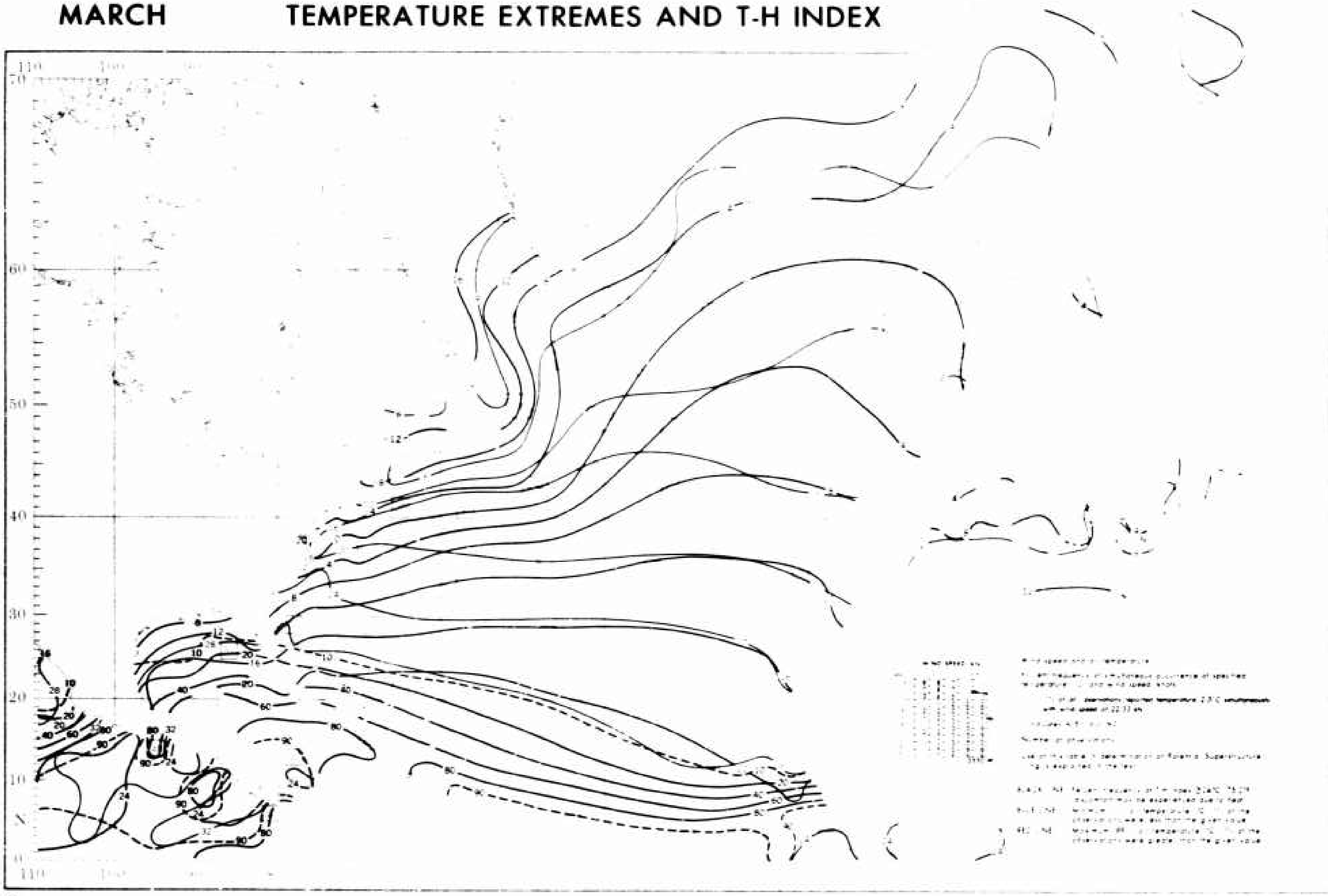


SURFACE AIR TEMPERATURE

MARCH

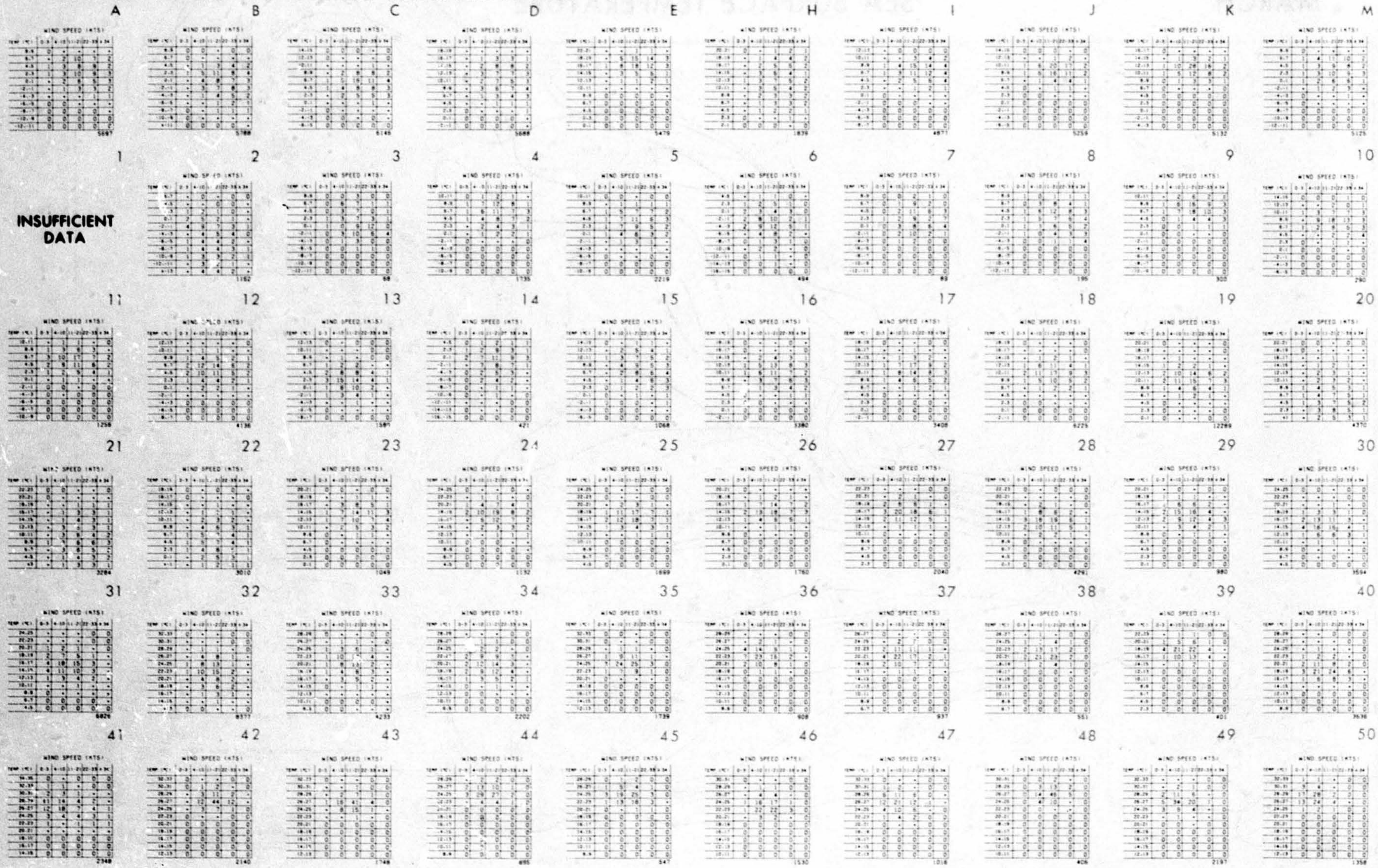


MARCH TEMPERATURE EXTREMES AND T-H INDEX



WIND SPEED AND AIR TEMPERATURE

MARCH



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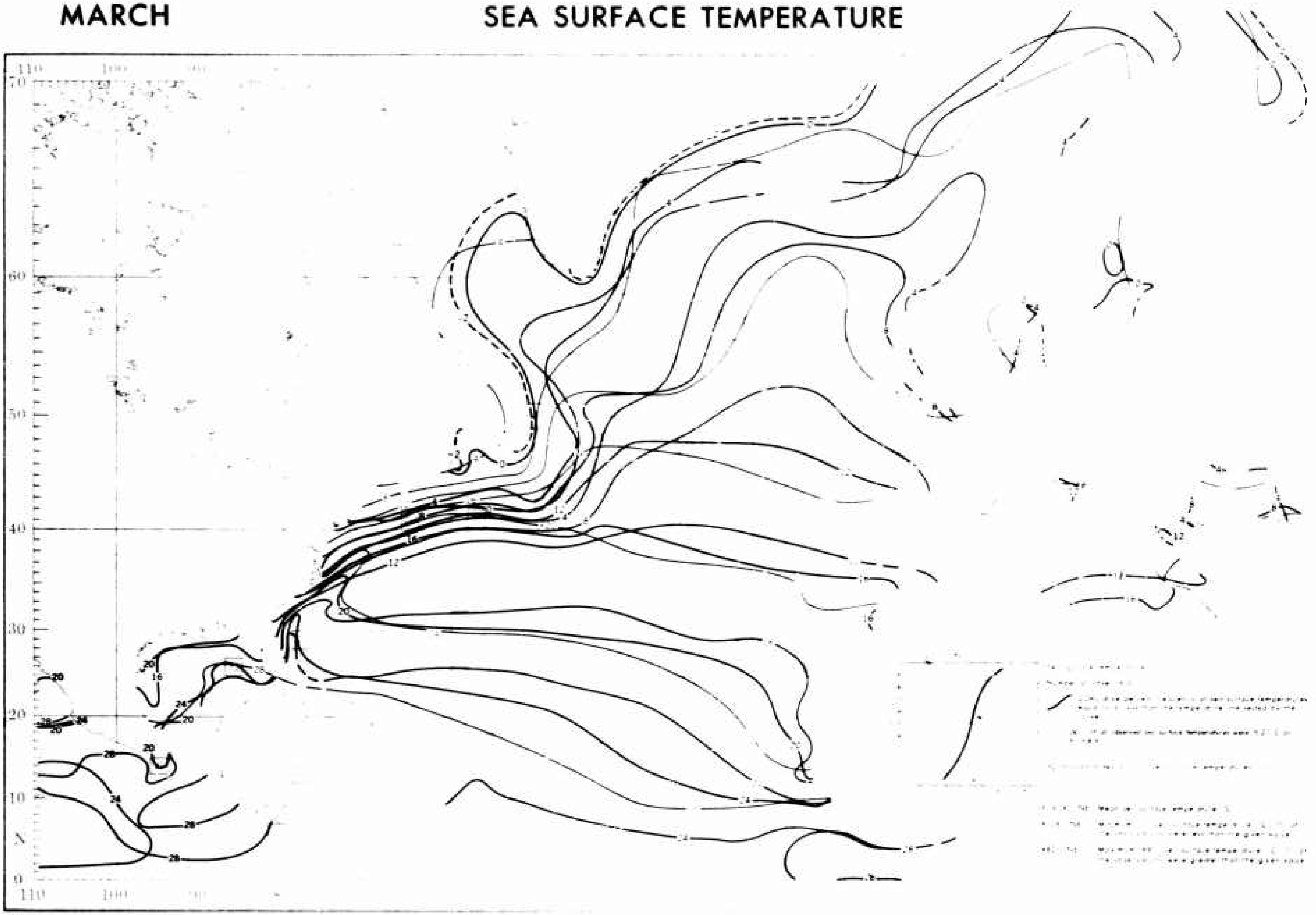
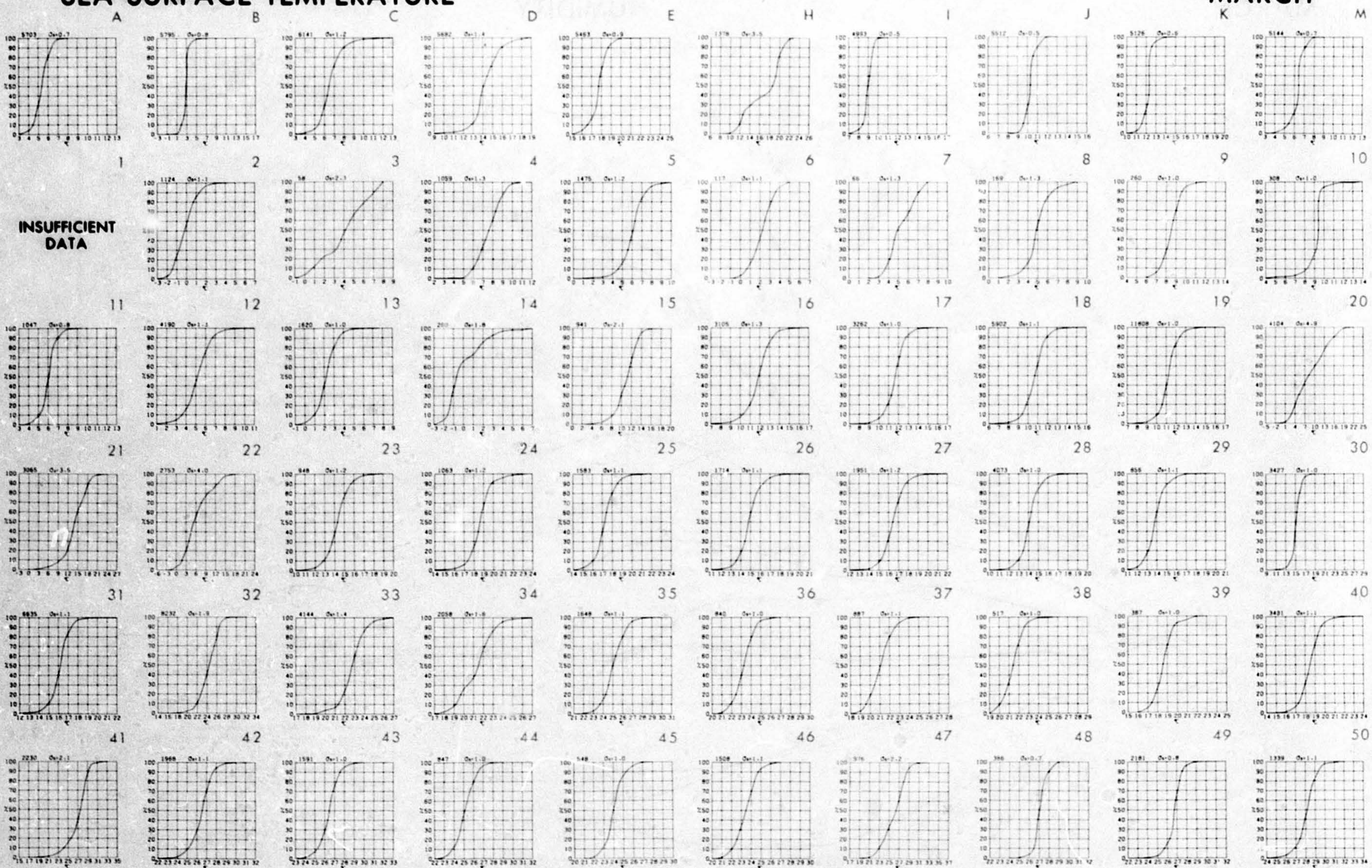
MARCH

SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE — MARCH



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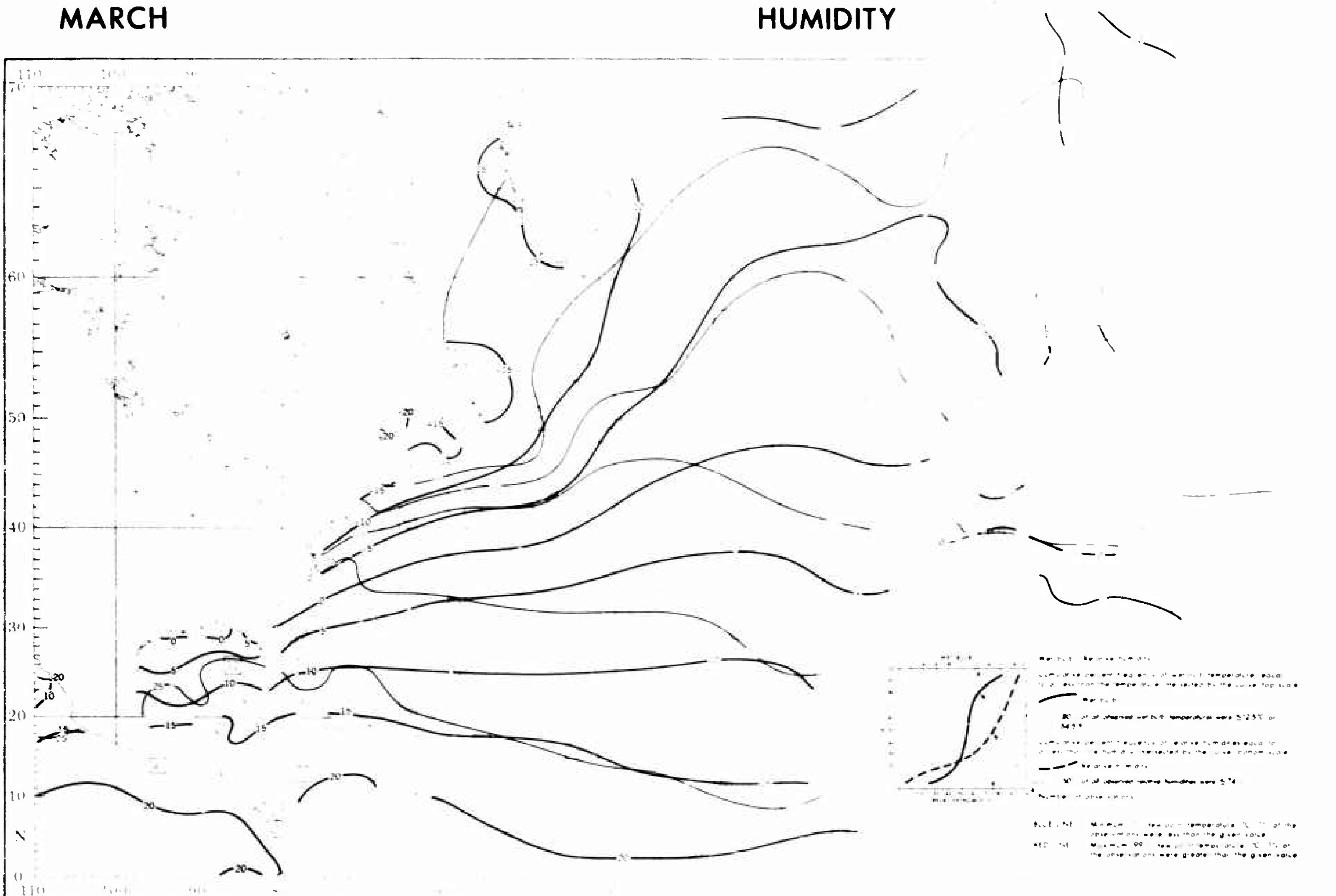
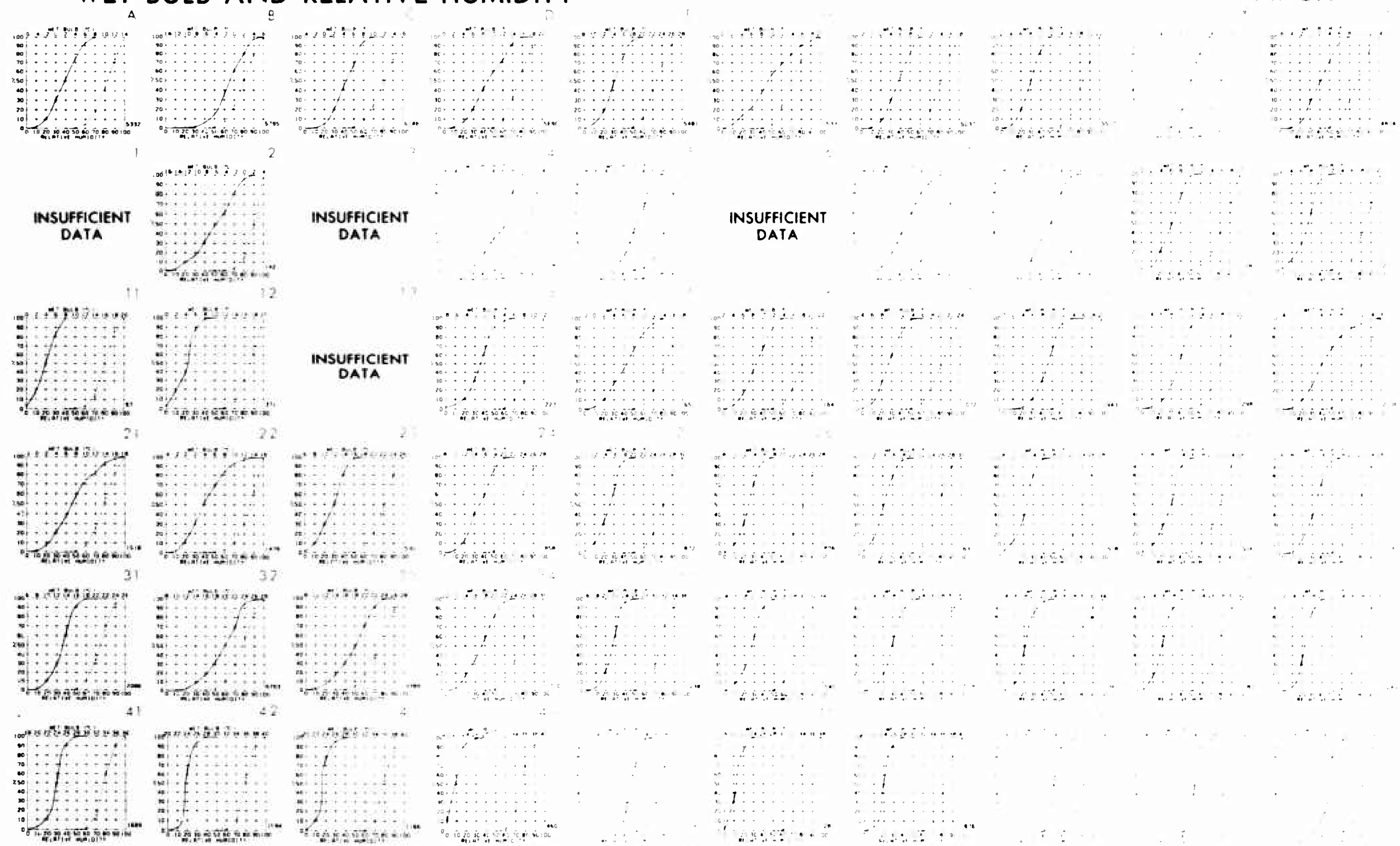
MARCH HUMIDITY

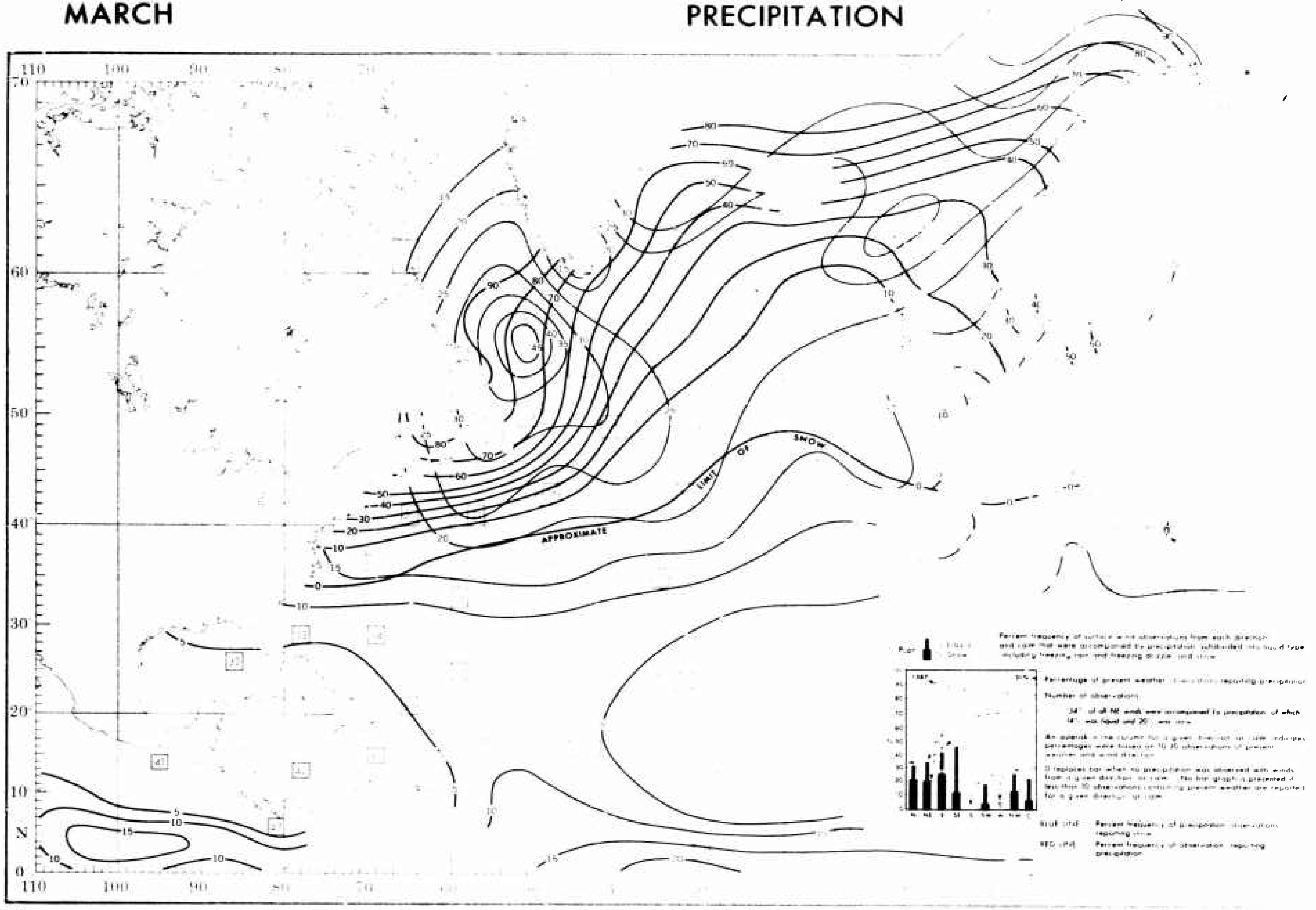


WET BULB AND RELATIVE HUMIDITY

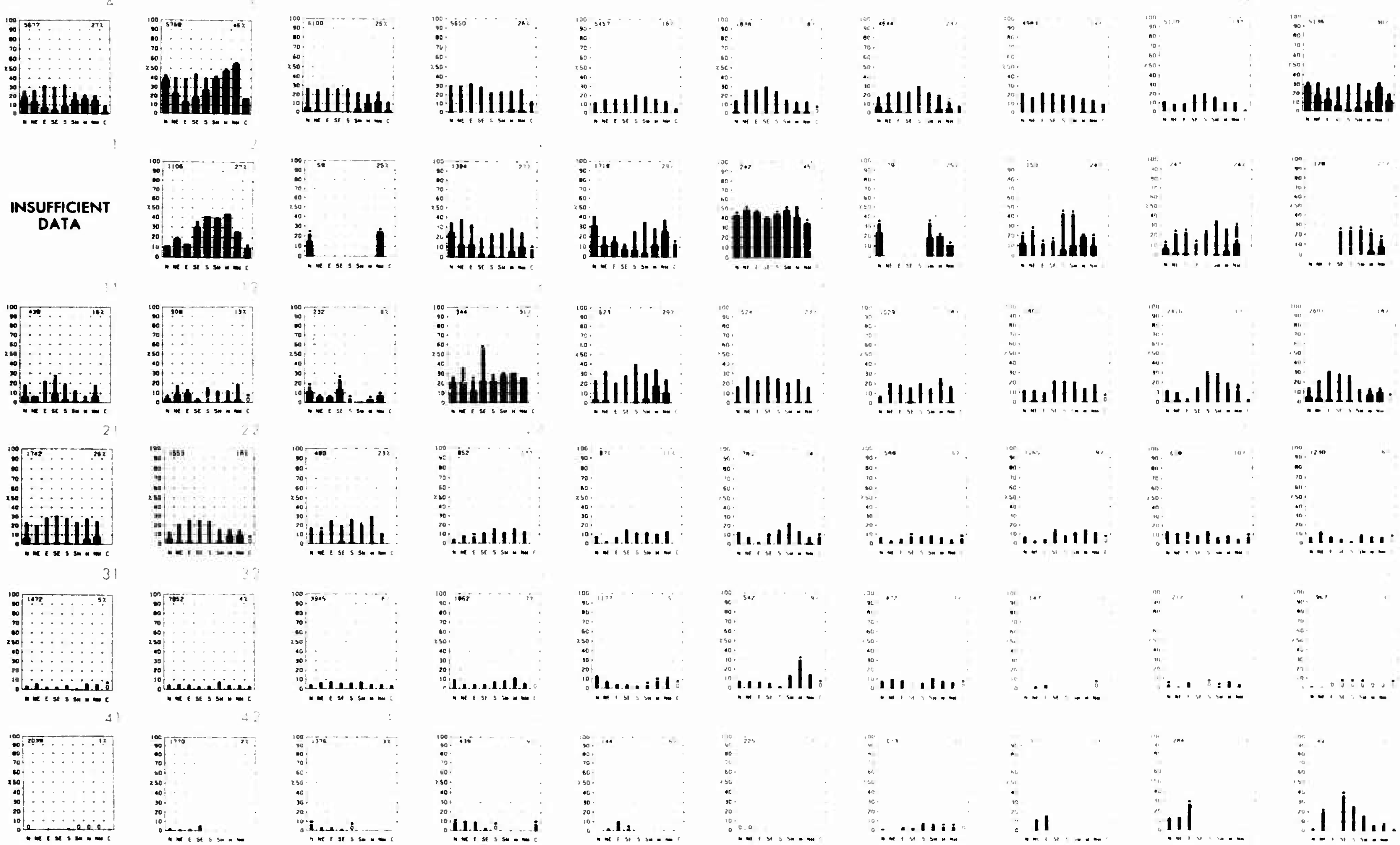
MARCH



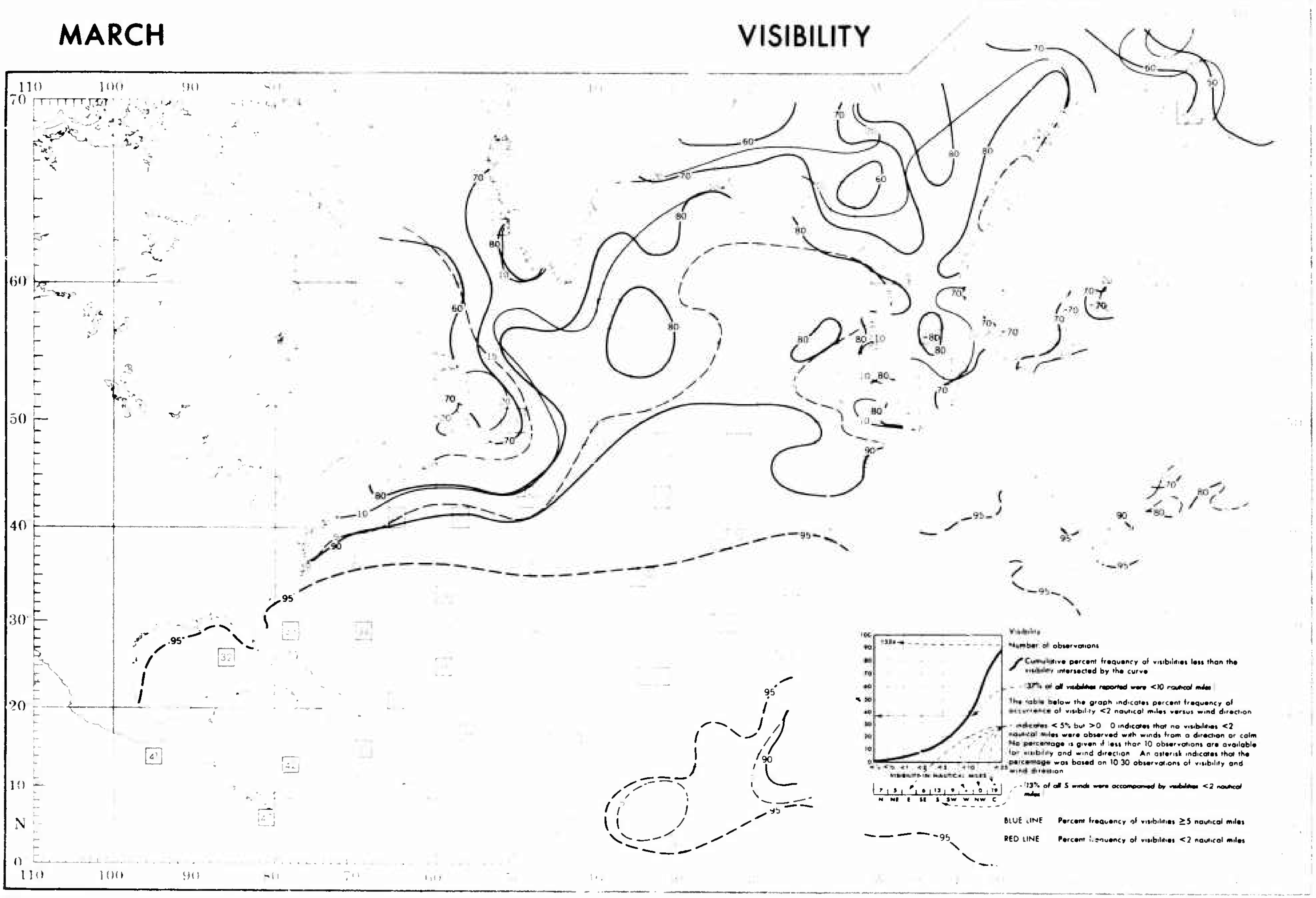
MARCH PRECIPITATION



PRECIPITATION MARCH

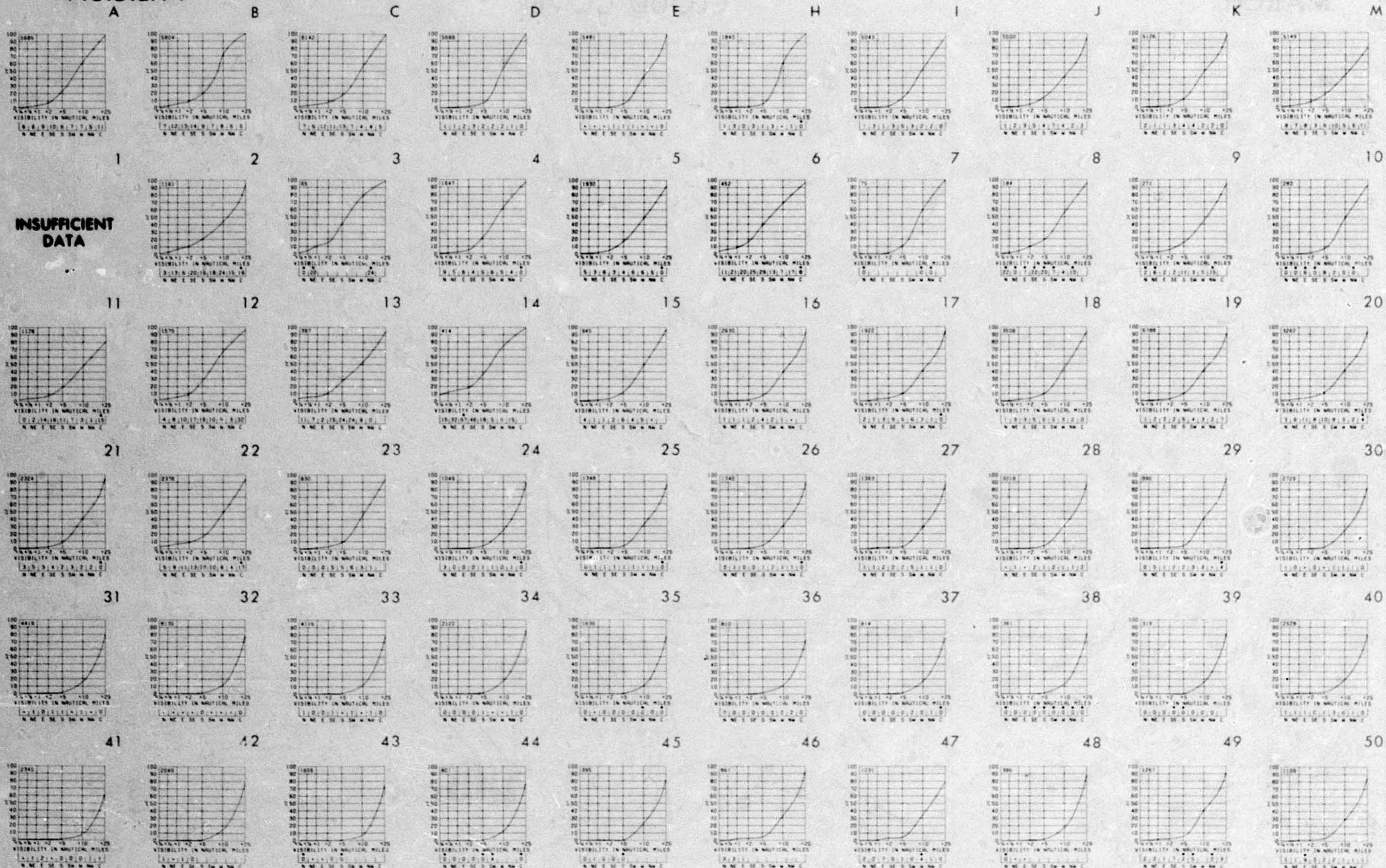


MARCH VISIBILITY



VISIBILITY

MARCH



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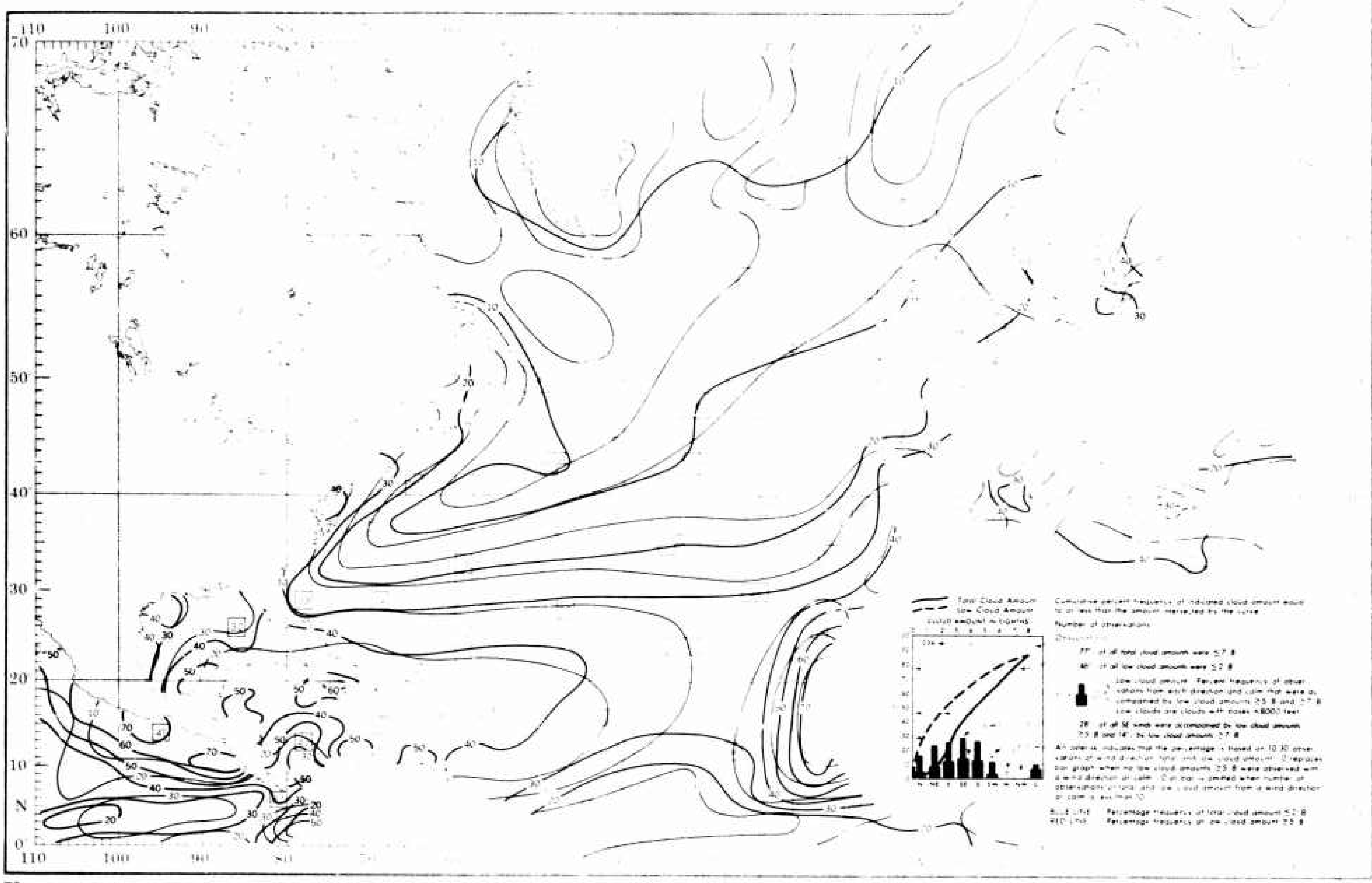
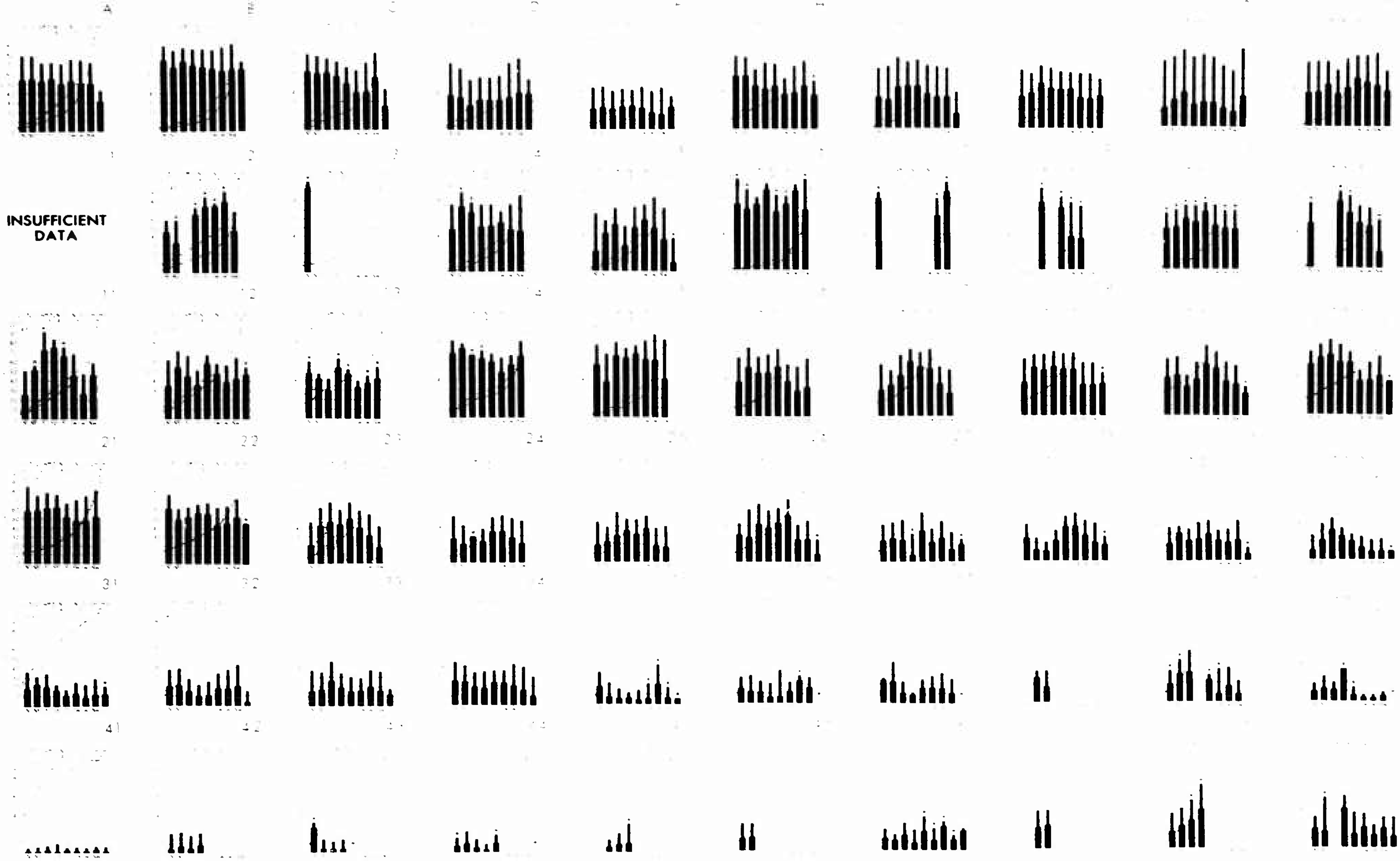
CLOUD COVER



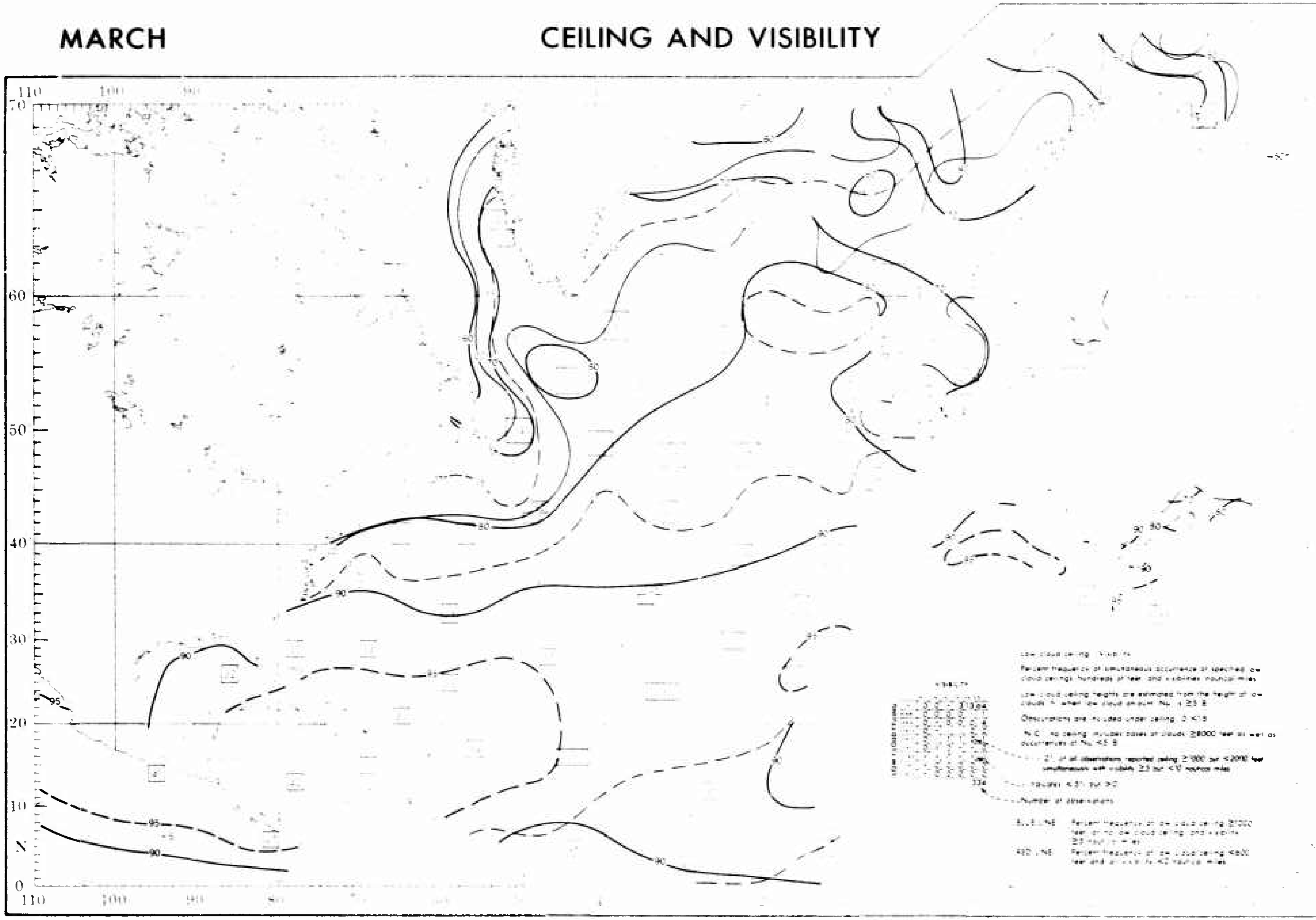
CLOUD COVER

MARCH



MARCH

CEILING AND VISIBILITY



CEILING AND VISIBILITY

MARCH

A B C D E H I J K M

1

LOW CLOUD CEILING	<1/2	1/2-1	1-2	2-5	5-10	>10
NC	•	•	•	2	8	17
50-80	0	0	0	•	•	•
35-50	0	0	•	•	1	2
20-35	•	•	•	1	10	9
10-20	•	1	1	5	17	8
6-10	•	•	1	3	1	1
3-6	•	1	1	2	•	•
1.5-3	•	•	•	•	•	0
0-1.5	•	•	•	0	0	0

5879

2

LOW CLOUD CEILING	<1/2	1/2-1	1-2	2-5	5-10	>10
NC	0	•	•	•	5	8
50-80	0	0	0	0	1	•
35-50	0	0	0	•	1	1
20-35	0	•	•	1	20	13
10-20	•	1	1	5	23	8
6-10	•	•	1	3	3	•
3-6	•	1	1	1	•	0
1.5-3	•	•	•	•	0	0
0-1.5	2	1	•	•	•	0

5801

3

LOW CLOUD CEILING	<1/2	1/2-1	1-2	2-5	5-10	>10
NC	•	•	•	1	10	18
50-80	0	0	•	•	1	1
35-50	•	•	•	•	2	3
20-35	0	•	•	1	11	12
10-20	•	•	1	4	13	8
6-10	•	•	1	2	3	1
3-6	•	•	1	1	•	•
1.5-3	•	•	•	•	•	•
0-1.5	3	1	•	•	•	0

6137

4

LOW CLOUD CEILING	<1/2	1/2-1	1-2	2-5	5-10	>10
NC	0	•	•	1	14	20
50-80	0	0	0	0	•	•
35-50	0	0	0	0	1	1
20-35	•	0	•	1	14	15
10-20	•	•	1	2	17	8
6-10	•	•	•	1	1	•
3-6	•	•	•	•	•	0
1.5-3	0	0	0	0	0	0
0-1.5	•	•	0	•	0	0

5579

5

LOW CLOUD CEILING	<1/2	1/2-1	1-2	2-5	5-10	>10
NC	•	•	•	2	15	38
50-80	0	0	•	•	1	1
35-50	0	0	0	•	1	1
20-35	•	•	0	1	10	12
10-20	•	•	•	1	7	5
6-10	0	•	•	•	1	•
3-6	0	•	0	•	•	0
1.5-3	•	0	0	0	0	•
0-1.5	•	0	•	•	0	0

5476

6 [illegible]

7 [illegible]

8 [illegible]

9 [illegible]

10 [illegible]

11

INSUFFICIENT DATA

12 [illegible]

13 [illegible]

14 [illegible]

15 [illegible]

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47 [illegible]

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49 [illegible]

50 [illegible]

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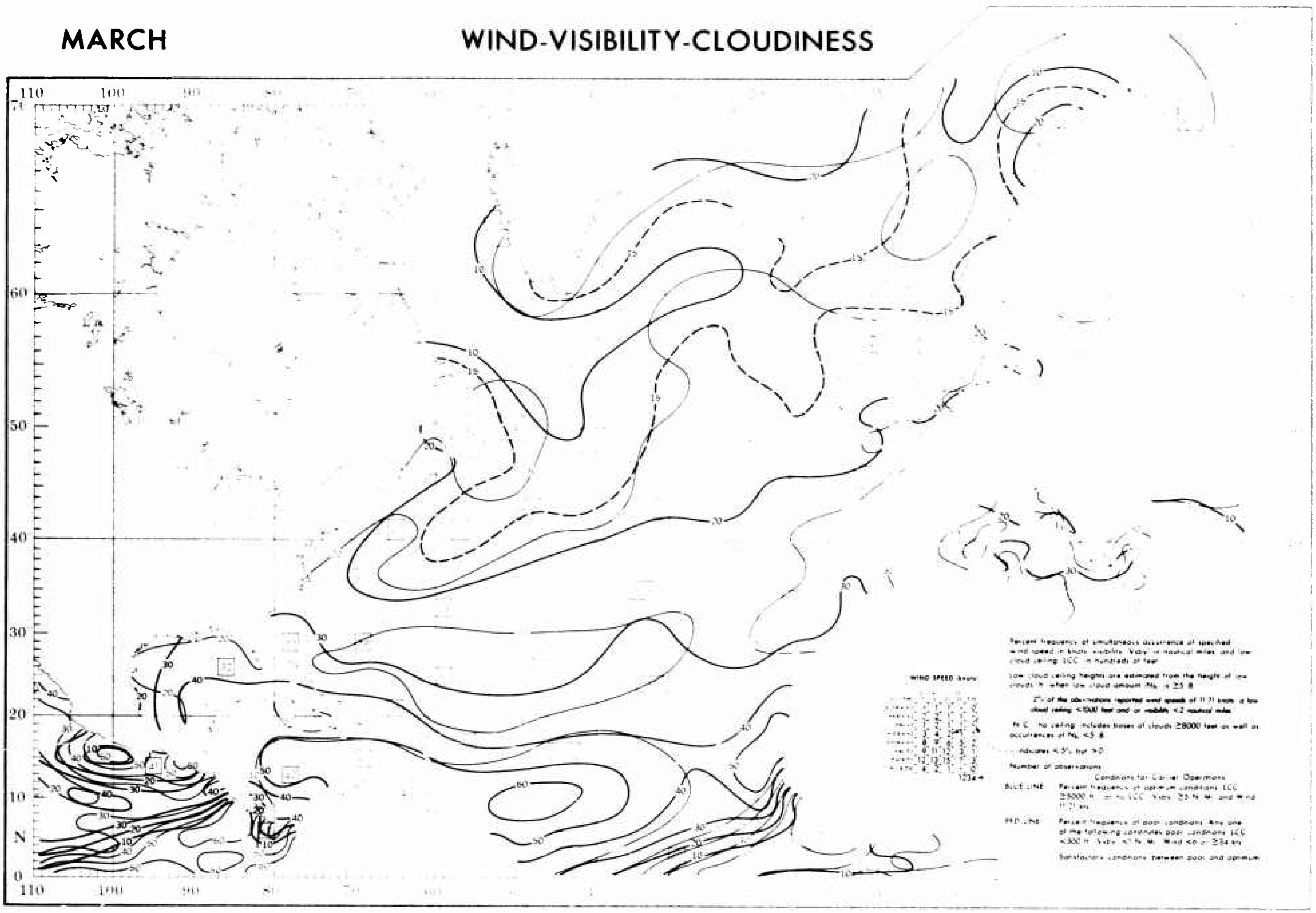
MARCH

WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

MARCH

A

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5474

B

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5761

C

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

6129

D

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5875

E

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5473

H

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1835

I

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

4871

J

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5220

K

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5110

M

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5103

1

INSUFFICIENT DATA

2

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	5	11	9	4	•

209

3

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	0	0	0	2	0

41

4

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	•	2	5	3	•

417

5

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	3	7	9	4	1

477

6

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	1	2	5	0	0

174

7

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	0	2	4	4	0

55

8

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	1	10	5	5	0

94

9

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	2	6	13	5	0

175

10

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<6 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<10 & OR <2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<20 & OR <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VSBY <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<50 & <5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NC & ≥10	1	3	12	6	1

156

11

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	1	•	0	0
<6 & OR <2	0	2	2	2	1
VSBY <2	0	2	2	2	1
<10 & OR <2	1	3	4	5	3
<20 & OR <5	3	6	13	9	6
VSBY <5	5	17	32	19	6
<50 & <5	2	9	16	5	4
NC & ≥10	1	5	9	6	2

247

12

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	1	2	2	•	•
<6 & OR <2	1	4	5	1	•
VSBY <2	1	2	3	•	•
<10 & OR <2	1	5	6	1	1
<20 & OR <5	2	8	17	7	3
VSBY <5	2	19	34	17	4
<50 & <5	1	11	18	7	1
NC & ≥10	1	7	12	4	1

743

13

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	1	3	•	1	0
<6 & OR <2	1	8	5	1	0
VSBY <2	1	8	4	1	0
<10 & OR <2	1	8	6	1	0
<20 & OR <5	2	14	22	2	1
VSBY <5	4	17	39	6	1
<50 & <5	3	13	24	5	1
NC & ≥10	1	8	16	3	1

202

14

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	3	6	4	2
<6 & OR <2	•	5	9	6	2
VSBY <2	0	5	8	4	2
<10 & OR <2	•	[illegible]	11	6	3
<20 & OR <5	2	12	22	16	8
VSBY <5	2	11	25	20	3
<50 & <5	1	5	11	7	0
NC & ≥10	1	4	5	5	0

300

15

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	•	1	•
<6 & OR <2	•	•	3	3	1
VSBY <2	•	•	1	•	1
<10 & OR <2	•	2	7	9	6
<20 & OR <5	•	5	17	18	14
VSBY <5	1	12	34	29	13
<50 & <5	•	5	10	6	2
NC & ≥10	•	5	8	4	1

831

16

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	1	•	•
<6 & OR <2	•	1	2	2	1
VSBY <2	•	•	•	•	•
<10 & OR <2	•	3	7	7	3
<20 & OR <5	•	7	16	14	7
VSBY <5	1	17	38	28	10
<50 & <5	•	9	17	11	3
NC & ≥10	•	8	15	9	2

1565

17

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	1	•
<6 & OR <2	•	1	2	2	1
VSBY <2	•	•	•	•	1
<10 & OR <2	•	2	7	6	3
<20 & OR <5	1	6	18	13	6
VSBY <5	3	18	42	23	7
<50 & <5	2	9	20	8	3
NC & ≥10	2	8	17	7	2

983

18

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	1	1	•	•
<6 & OR <2	•	2	3	2	1
VSBY <2	0	1	•	•	•
<10 & OR <2	•	5	9	6	2
<20 & OR <5	1	9	23	11	3
VSBY <5	3	23	45	18	4
<50 & <5	1	11	20	6	2
NC & ≥10	1	9	16	5	1

1782

19

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	•	•
<6 & OR <2	•	1	2	1	•
VSBY <2	•	•	1	•	•
<10 & OR <2	•	3	6	4	1
<20 & OR <5	1	9	15	5	2
VSBY <5	4	28	40	16	3
<50 & <5	2	15	20	6	1
NC & ≥10	2	12	16	4	1

2557

20

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	1	1	1	•
<6 & OR <2	•	2	3	2	1
VSBY <2	•	1	1	1	1
<10 & OR <2	•	3	7	6	3
<20 & OR <5	1	6	17	14	6
VSBY <5	2	17	40	26	6
<50 & <5	1	10	19	8	2
NC & ≥10	1	9	15	6	1

2310

21

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	1	1	•
<6 & OR <2	0	1	3	3	2
VSBY <2	0	•	1	1	1
<10 & OR <2	•	2	9	8	5
<20 & OR <5	•	5	21	20	10
VSBY <5	1	13	39	29	11
<50 & <5	1	6	12	5	1
NC & ≥10	•	5	10	3	1

1547

22

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	2	2	1	•
<6 & OR <2	•	2	5	3	1
VSBY <2	•	2	2	1	1
<10 & OR <2	•	4	10	8	3
<20 & OR <5	1	10	19	15	5
VSBY <5	2	20	36	22	6
<50 & <5	1	10	16	8	1
NC & ≥10	1	9	12	5	1

1419

23

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	•	•
<6 & OR <2	0	•	2	2	2
VSBY <2	0	0	1	•	1
<10 & OR <2	1	2	6	8	4
<20 & OR <5	1	8	14	13	6
VSBY <5	1	19	39	25	10
<50 & <5	•	11	20	11	3
NC & ≥10	•	9	17	9	2

471

24

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	1	•	0
<6 & OR <2	0	•	1	1	1
VSBY <2	0	0	•	0	•
<10 & OR <2	0	2	6	4	2
<20 & OR <5	•	6	17	10	4
VSBY <5	2	21	43	23	7
<50 & <5	2	14	26	10	3
NC & ≥10	2	13	24	8	2

774

25

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	•	0
<6 & OR <2	0	•	2	1	•
VSBY <2	0	0	•	0	0
<10 & OR <2	0	2	5	4	1
<20 & OR <5	•	6	12	9	2
VSBY <5	3	26	45	20	4
<50 & <5	2	18	29	8	2
NC & ≥10	2	17	26	6	1

813

26

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	•	•
<6 & OR <2	•	1	1	1	•
VSBY <2	0	•	•	•	0
<10 & OR <2	•	2	5	5	1
<20 & OR <5	1	7	16	10	2
VSBY <5	5	23	45	22	4
<50 & <5	3	12	21	11	1
NC & ≥10	3	11	18	9	1

792

27

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	0	0
<6 & OR <2	0	1	1	0	0
VSBY <2	0	•	0	0	0
<10 & OR <2	•	3	4	1	0
<20 & OR <5	1	6	11	4	0
VSBY <5	8	36	43	12	1
<50 & <5	6	25	24	6	1
NC & ≥10	5	22	21	4	1

593

28

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	•	0
<6 & OR <2	0	1	1	•	0
VSBY <2	0	•	•	•	0
<10 & OR <2	•	3	4	1	0
<20 & OR <5	1	8	11	3	•
VSBY <5	6	35	42	10	1
<50 & <5	5	26	26	6	1
NC & ≥10	5	23	22	5	•

1327

29

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	1	•	•	0
<6 & OR <2	0	1	1	•	•
VSBY <2	0	1	1	•	•
<10 & OR <2	0	1	2	1	•
<20 & OR <5	0	3	9	3	2
VSBY <5	4	32	42	13	4
<50 & <5	4	26	28	7	2
NC & ≥10	2	18	16	3	1

600

30

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	0	0	0
<6 & OR <2	0	•	1	•	•
VSBY <2	0	0	0	•	0
<10 & OR <2	•	1	3	1	•
<20 & OR <5	1	3	6	3	1
VSBY <5	5	39	40	11	2
<50 & <5	4	33	29	7	1
NC & ≥10	4	28	23	5	1

1341

31

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	•	0
<6 & OR <2	0	•	•	•	0
VSBY <2	0	•	0	0	0
<10 & OR <2	•	1	1	1	0
<20 & OR <5	1	3	6	3	•
VSBY <5	5	40	43	11	•
<50 & <5	4	34	32	6	•
NC & ≥10	4	31	29	5	•

1704

32

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	•	•	•
<6 & OR <2	•	•	1	•	•
VSBY <2	•	•	•	•	•
<10 & OR <2	•	2	6	2	•
<20 & OR <5	•	4	13	4	•
VSBY <5	2	31	56	10	1
<50 & <5	2	25	39	5	•
NC & ≥10	2	24	36	4	•

7373

33

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	•	•	0
<6 & OR <2	•	•	1	1	•
VSBY <2	0	0	•	•	0
<10 & OR <2	•	2	5	2	•
<20 & OR <5	•	5	12	5	1
VSBY <5	3	29	52	14	2
<50 & <5	2	22	35	7	•
NC & ≥10	2	21	33	6	•

3654

34

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	•	0	0
<6 & OR <2	•	1	1	1	•
VSBY <2	0	0	0	•	0
<10 & OR <2	•	3	4	2	•
<20 & OR <5	1	7	12	5	1
VSBY <5	6	35	45	12	1
<50 & <5	5	25	28	5	1
NC & ≥10	5	23	25	5	•

1689

35

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	•	0	•	0
VSBY <2	0	0	0	•	0
<10 & OR <2	•	1	1	•	0
<20 & OR <5	•	4	6	1	0
VSBY <5	5	41	49	4	0
<50 & <5	5	35	40	3	0
NC & ≥10	5	34	38	2	0

1085

36

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	•	•	1	0
VSBY <2	0	0	•	•	0
<10 & OR <2	•	1	2	1	0
<20 & OR <5	1	5	8	2	•
VSBY <5	10	45	39	4	•
<50 & <5	8	37	28	3	0
NC & ≥10	8	35	27	3	0

551

37

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	•	1	•	0
VSBY <2	0	0	0	0	0
<10 & OR <2	•	2	4	1	0
<20 & OR <5	1	5	8	2	1
VSBY <5	7	45	38	6	2
<50 & <5	6	36	25	4	1
NC & ≥10	6	35	23	3	1

494

38

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	0	1	1	0
VSBY <2	0	0	0	0	0
<10 & OR <2	0	1	7	1	0
<20 & OR <5	1	1	11	2	0
VSBY <5	10	30	52	6	0
<50 & <5	8	27	34	2	0
NC & ≥10	8	26	33	2	0

176

39

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	1	1	0	0
VSBY <2	0	0	0	0	0
<10 & OR <2	0	2	4	1	0
<20 & OR <5	1	7	9	2	0
VSBY <5	5	37	45	13	1
<50 & <5	4	26	25	8	1
NC & ≥10	3	25	23	8	1

173

40

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	0	0
<6 & OR <2	0	•	•	•	0
VSBY <2	0	0	•	0	0
<10 & OR <2	0	1	1	1	0
<20 & OR <5	•	2	6	2	•
VSBY <5	5	37	45	10	•
<50 & <5	4	33	37	7	0
NC & ≥10	4	31	32	6	0

1096

41

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	0	0	0	0
<6 & OR <2	•	•	•	•	•
VSBY <2	•	0	0	0	•
<10 & OR <2	•	•	•	•	•
<20 & OR <5	1	1	1	•	•
VSBY <5	20	41	18	13	3
<50 & <5	27	38	17	9	3
NC & ≥10	25	38	16	9	2

1850

42

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	0	0
<6 & OR <2	0	•	•	•	0
VSBY <2	0	0	0	•	0
<10 & OR <2	0	1	2	1	•
<20 & OR <5	•	2	9	3	•
VSBY <5	1	17	64	17	1
<50 & <5	•	15	52	13	•
NC & ≥10	•	14	48	11	•

1500

43

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	0	0
<6 & OR <2	0	•	1	0	0
VSBY <2	0	0	0	0	0
<10 & OR <2	0	•	2	•	0
<20 & OR <5	•	1	6	1	0
VSBY <5	1	26	67	6	•
<50 & <5	1	24	58	4	•
NC & ≥10	1	23	57	4	•

1287

44

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	0	0	0
<6 & OR <2	0	0	0	0	0
VSBY <2	0	0	0	0	0
<10 & OR <2	0	•	2	•	0
<20 & OR <5	•	3	5	1	0
VSBY <5	7	46	43	4	0
<50 & <5	7	41	35	3	0
NC & ≥10	7	41	35	2	0

437

45

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	1	0	0
<6 & OR <2	0	1	1	0	0
VSBY <2	0	0	0	0	0
<10 & OR <2	0	3	5	0	0
<20 & OR <5	0	4	9	0	0
VSBY <5	2	42	55	1	1
<50 & <5	2	36	43	1	1
NC & ≥10	2	36	40	1	1

137

46

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	•	•	•	0	0
<6 & OR <2	•	1	•	0	0
VSBY <2	0	1	0	0	0
<10 & OR <2	•	2	2	0	0
<20 & OR <5	1	5	8	•	0
VSBY <5	4	48	42	4	0
<50 & <5	3	38	29	4	0
NC & ≥10	2	33	25	3	0

261

47

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	0	0
<6 & OR <2	•	0	•	0	0
VSBY <2	0	0	0	0	0
<10 & OR <2	1	1	1	0	0
<20 & OR <5	3	5	2	0	0
VSBY <5	23	49	26	1	•
<50 & <5	18	41	23	1	•
NC & ≥10	14	37	21	•	•

618

48

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	0	0	0
<6 & OR <2	0	1	2	0	0
VSBY <2	0	•	0	0	0
<10 & OR <2	0	3	11	1	0
<20 & OR <5	0	7	23	3	0
VSBY <5	0	17	74	8	[illegible]
<50 & <5	0	8	45	[illegible]	0
NC & ≥10	0	8	44	5	0

299

49

WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	•	•	0	0
<6 & OR <2	0	1	•	0	0
VSBY <2	0	0	•	0	0
<10 & OR <2	1	10	3	0	0
<20 & OR <5	2	21	6	0	0
VSBY <5	10	64	25	0	0
<50 & <5	7	35	17	0	0
NC & ≥10	5	31	16	0	0

320

50

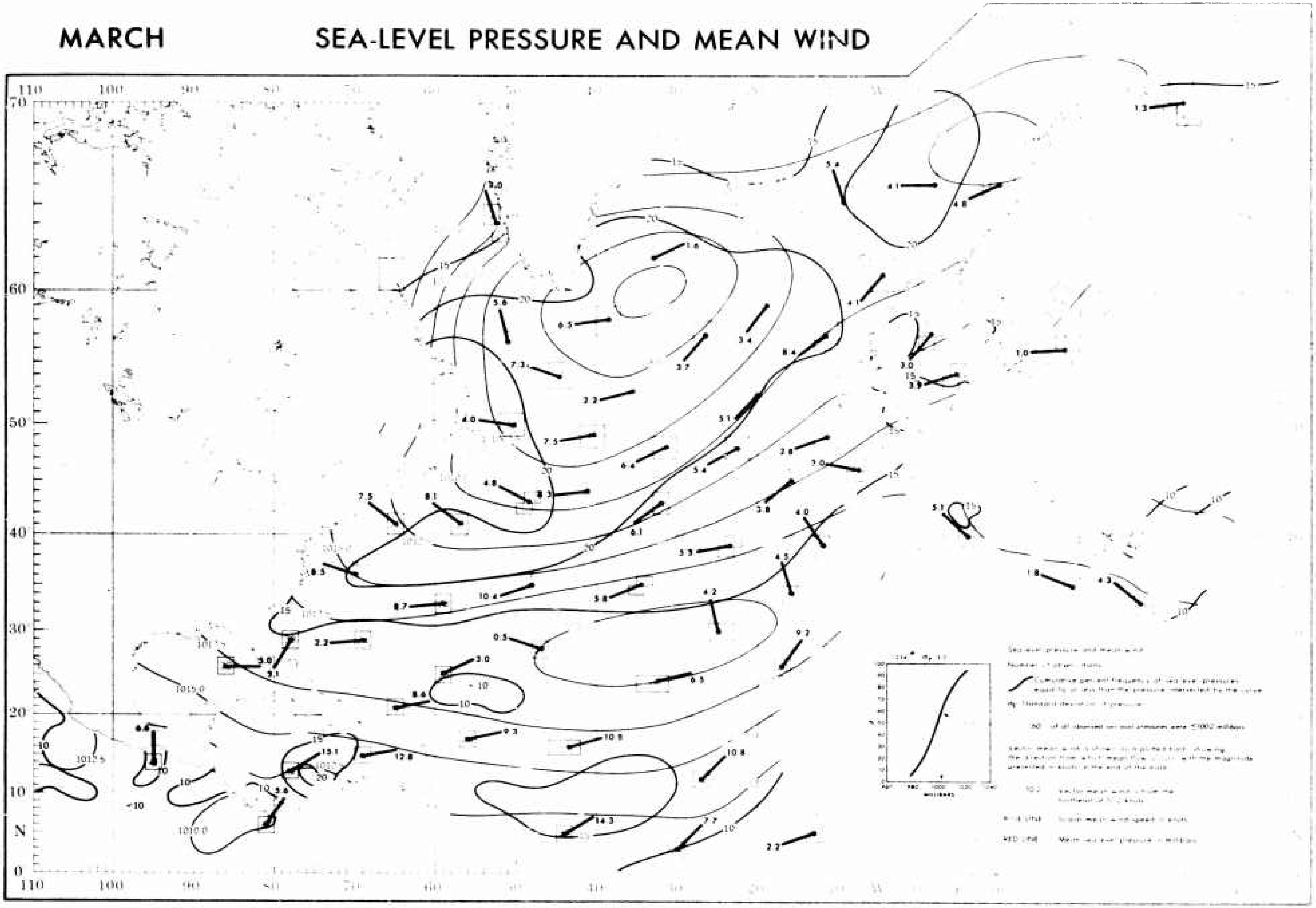
WIND SPEED (KNOTS)

LCC - VSBY	0-3	4-10	11-21	22-33	≥34
<1.5 & OR <.5	0	0	•	0	0
<6 & OR <2	•	1	•	0	0
VSBY <2	0	0	•	0	0
<10 & OR <2	2	2	2	0	0
<20 & OR <5	5	10	3	0	0
VSBY <5	35	57	7	0	0
<50 & <5	25	41	3	0	0
NC & ≥10	21	37	3	0	0

556

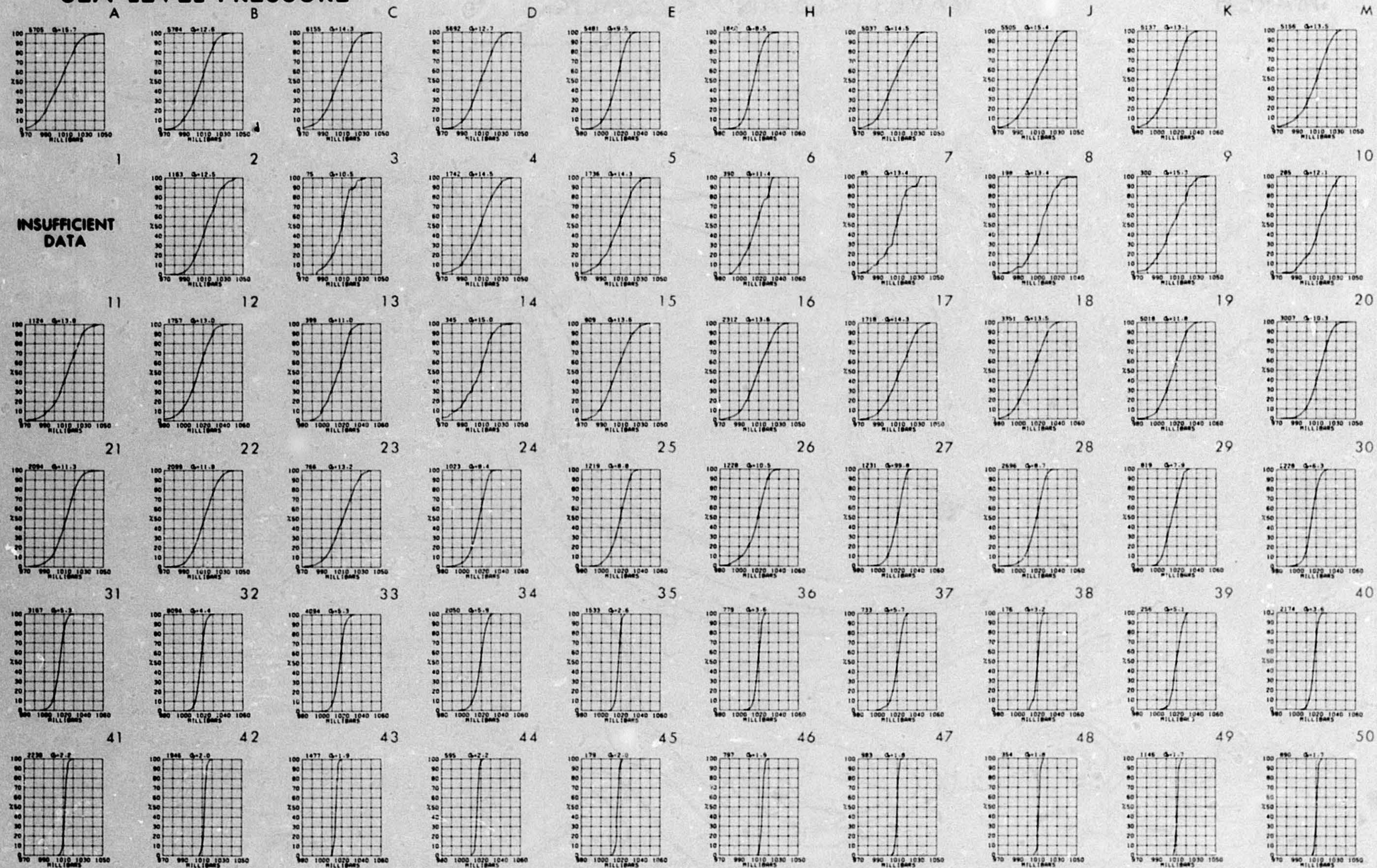
Graphs represent the objective compilation of available data for specified areas without regard to suspected biases.
The isopleth analyses (opposite page) are based on all available data subjectively adjusted where bias was evident.

MARCH SEA-LEVEL PRESSURE AND MEAN WIND



SEA LEVEL PRESSURE

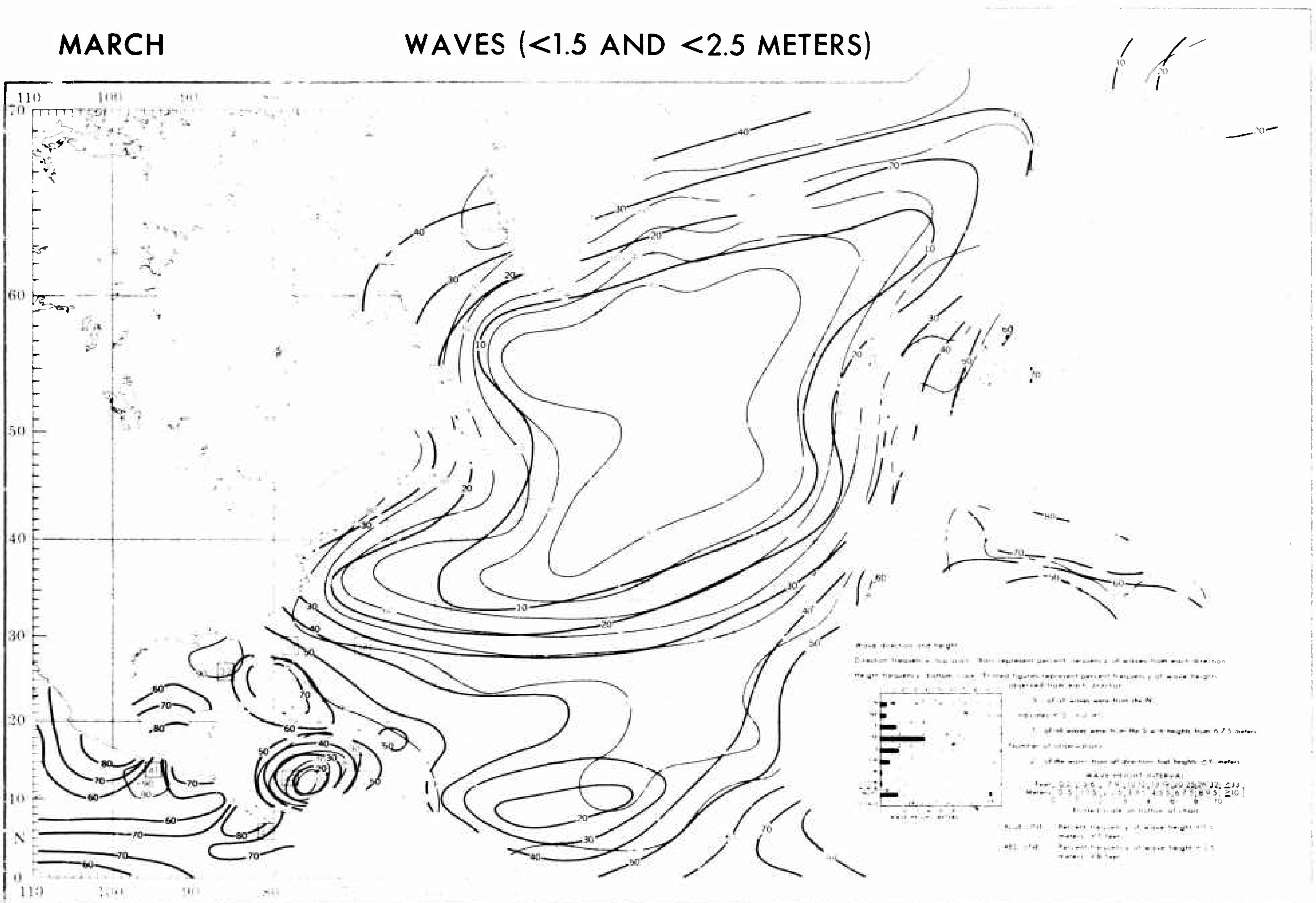
MARCH



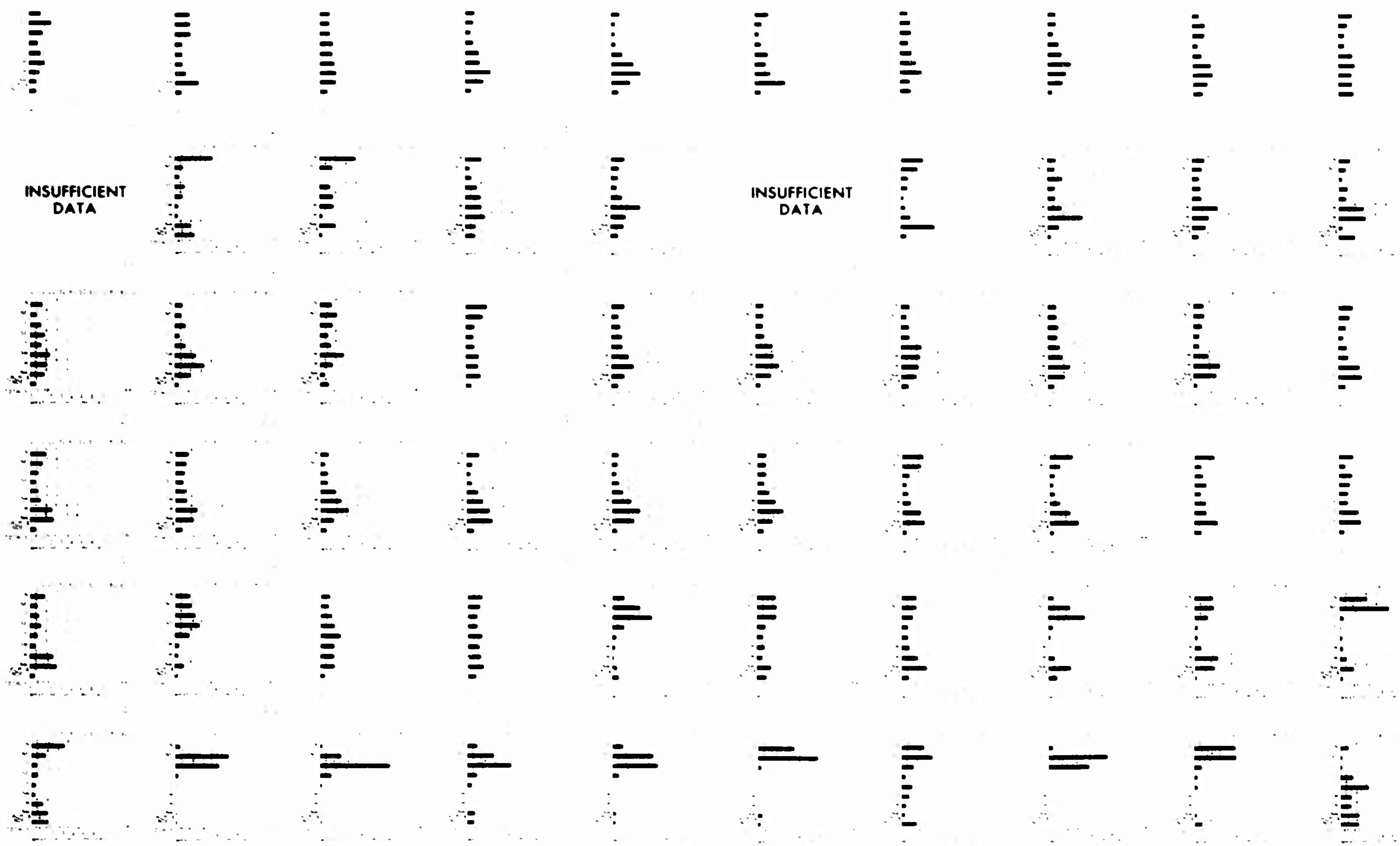
<u>Graphs</u> represent the objective compilation of available data for specified areas without regard to suspected biases.
The <u>isopleth</u> analyses (opposite page) are based on all available data subjectively adjusted where bias was evident.

MARCH

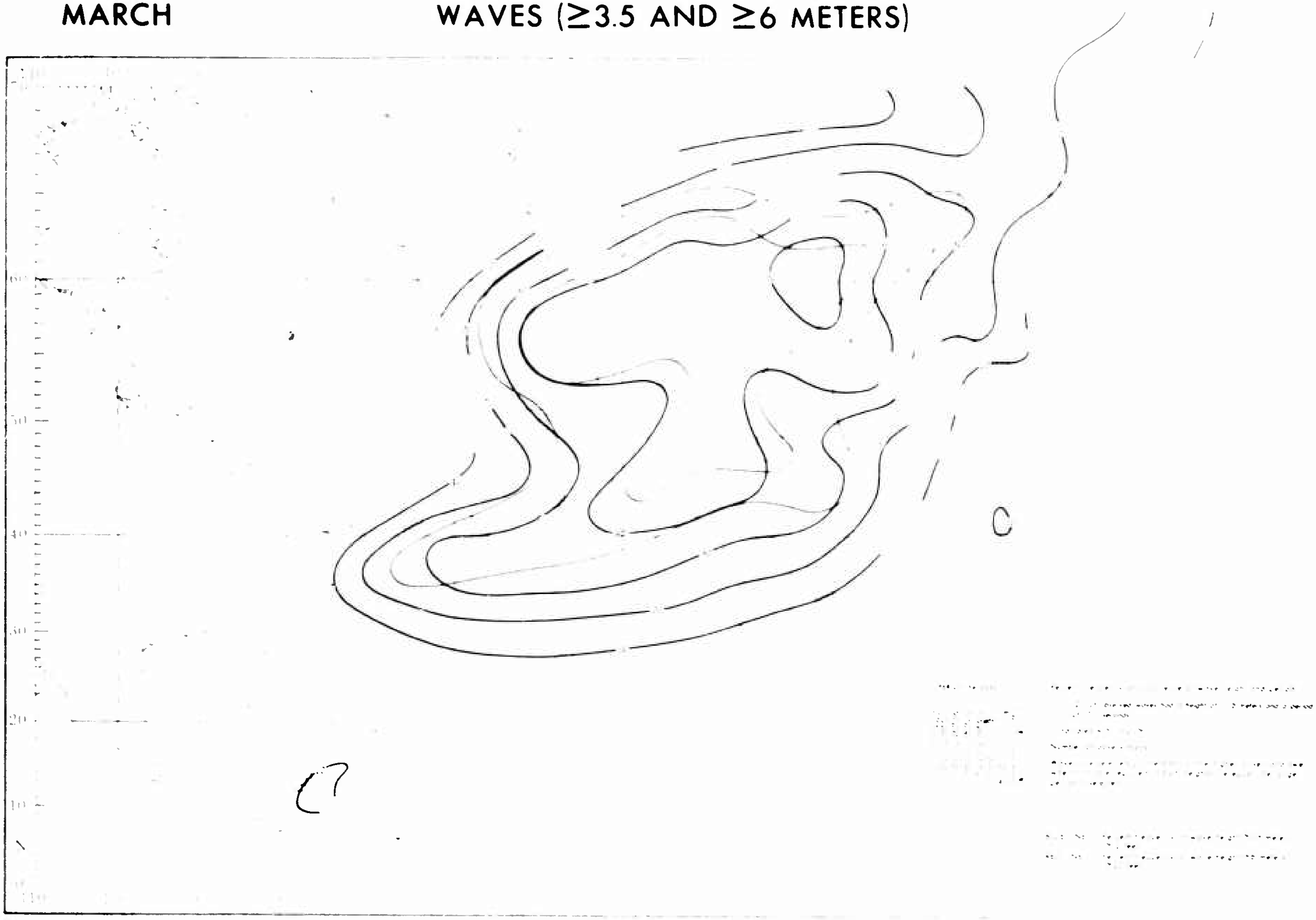
WAVES (<1.5 AND <2.5 METERS)



WAVE DIRECTION AND HEIGHT MARCH



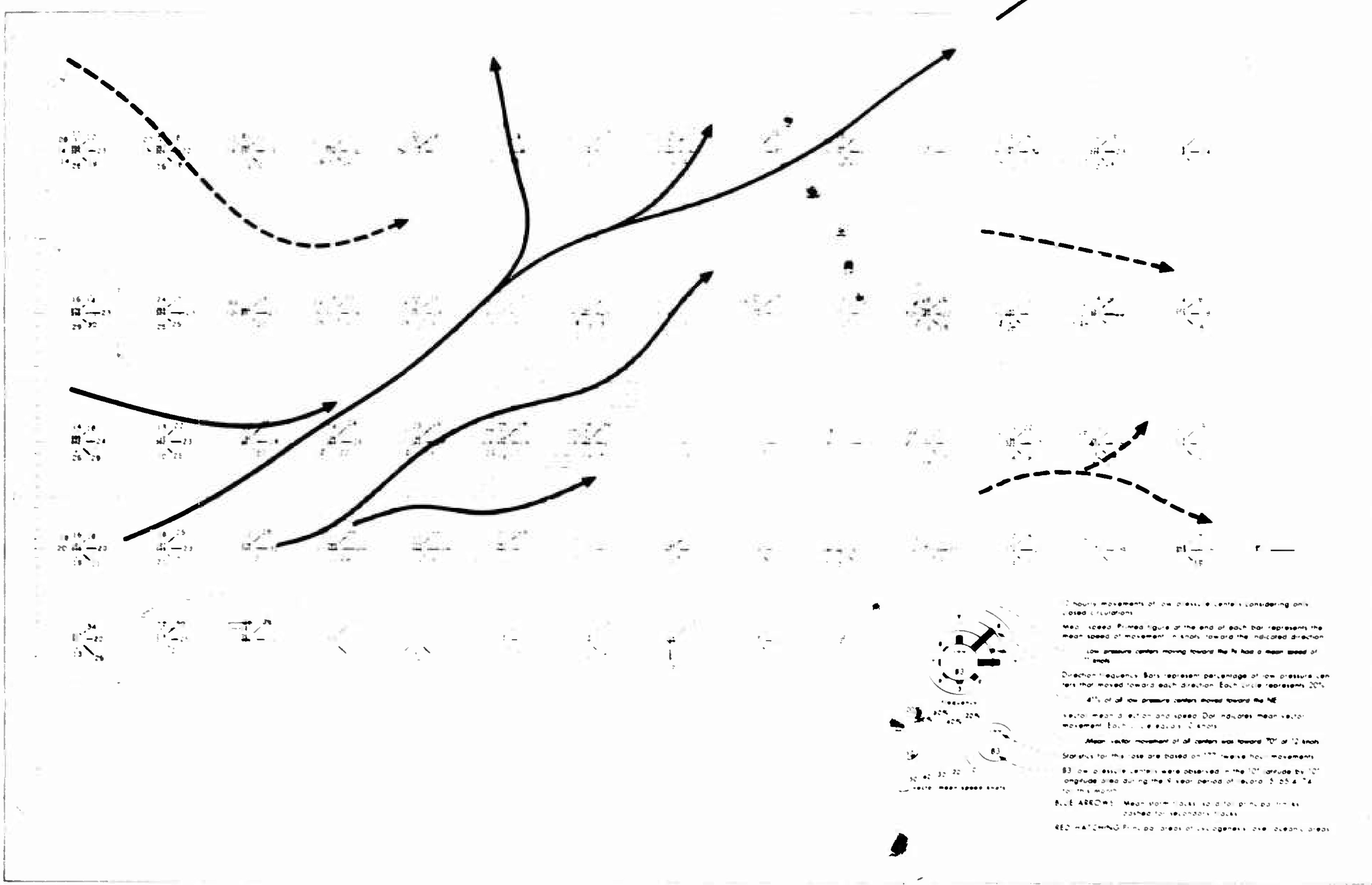
MARCH WAVES (≥3.5 AND ≥6 METERS)



WAVE PERIOD AND HEIGHT

MARCH

MARCH LOW PRESSURE CENTERS



TROPICAL CYCLONE

MARCH

12 hourly movements of tropical cyclone centers with tropical storm intensity or greater; wind speed estimated ≥34 knots

Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

Centers moving toward the N had a mean speed of 5 knots.

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

35% of all tropical cyclones moved toward the NE.

Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

Mean vector movement of all centers was toward 75° at 7 knots.

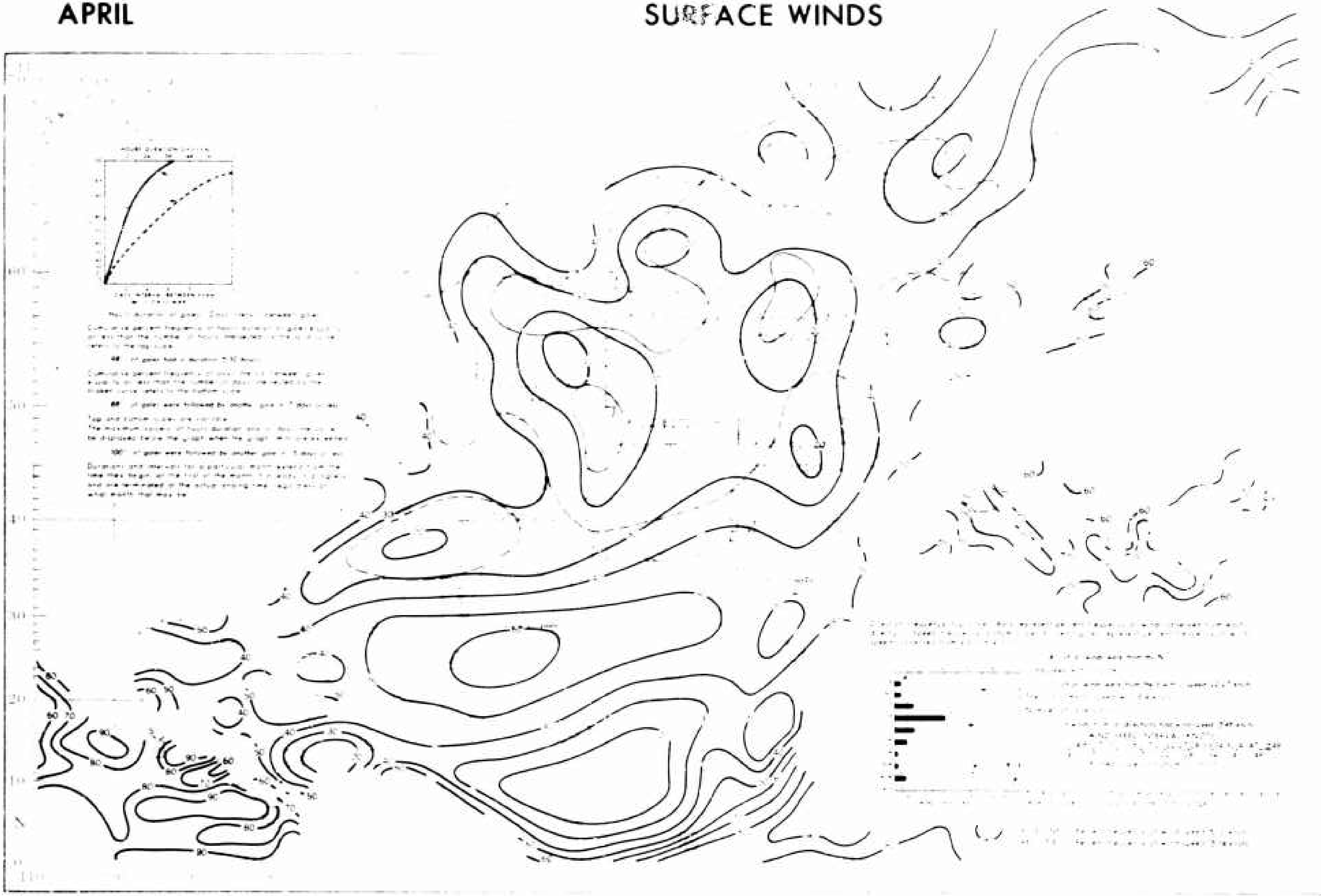
Statistics for this rose are based on 277 twelve hour movements.

50 individual storms were observed in the 5° X 5° area during the period of record.

Probability of having at least one tropical cyclone in this area in any given year for this month is 26%.

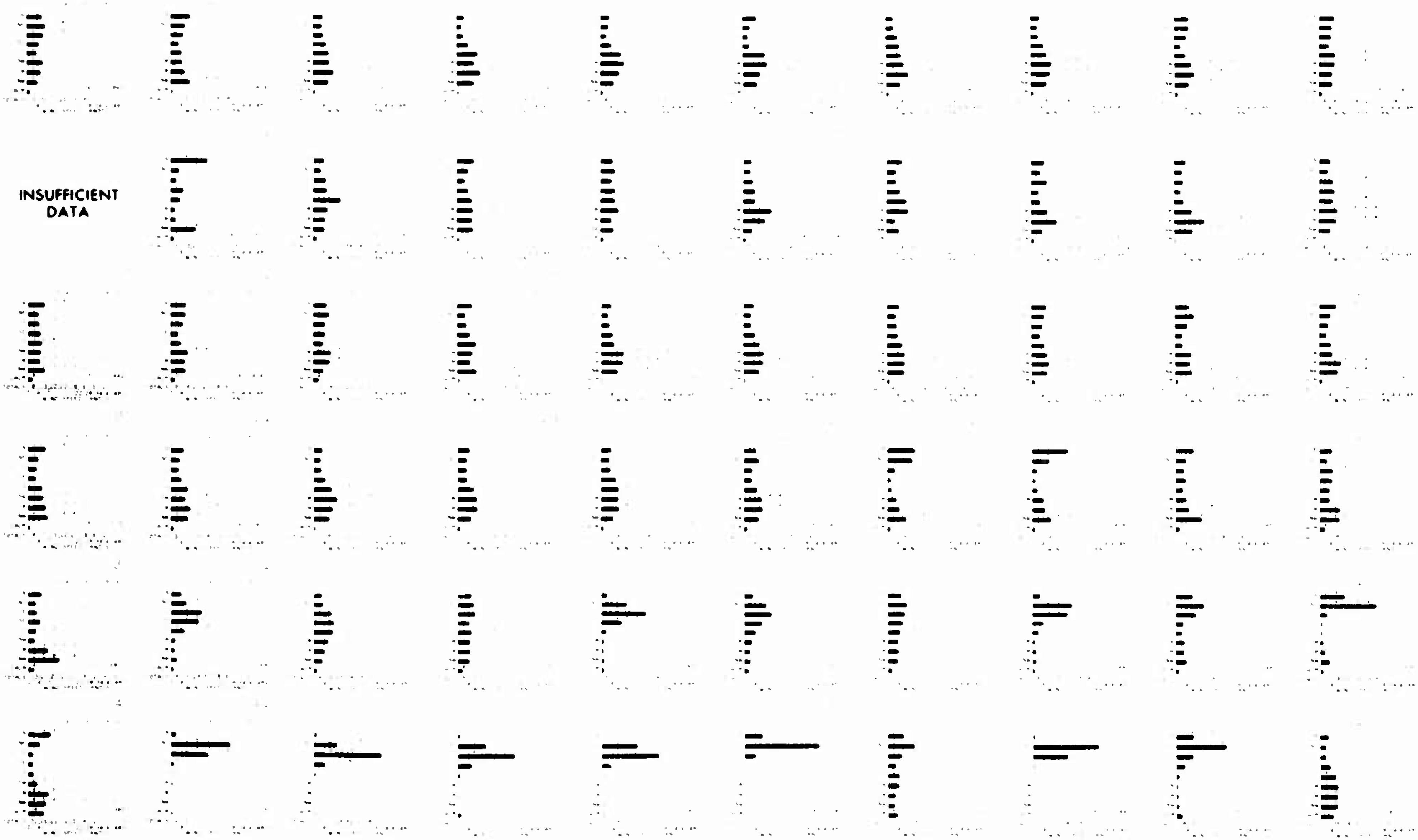
APRIL

SURFACE WINDS



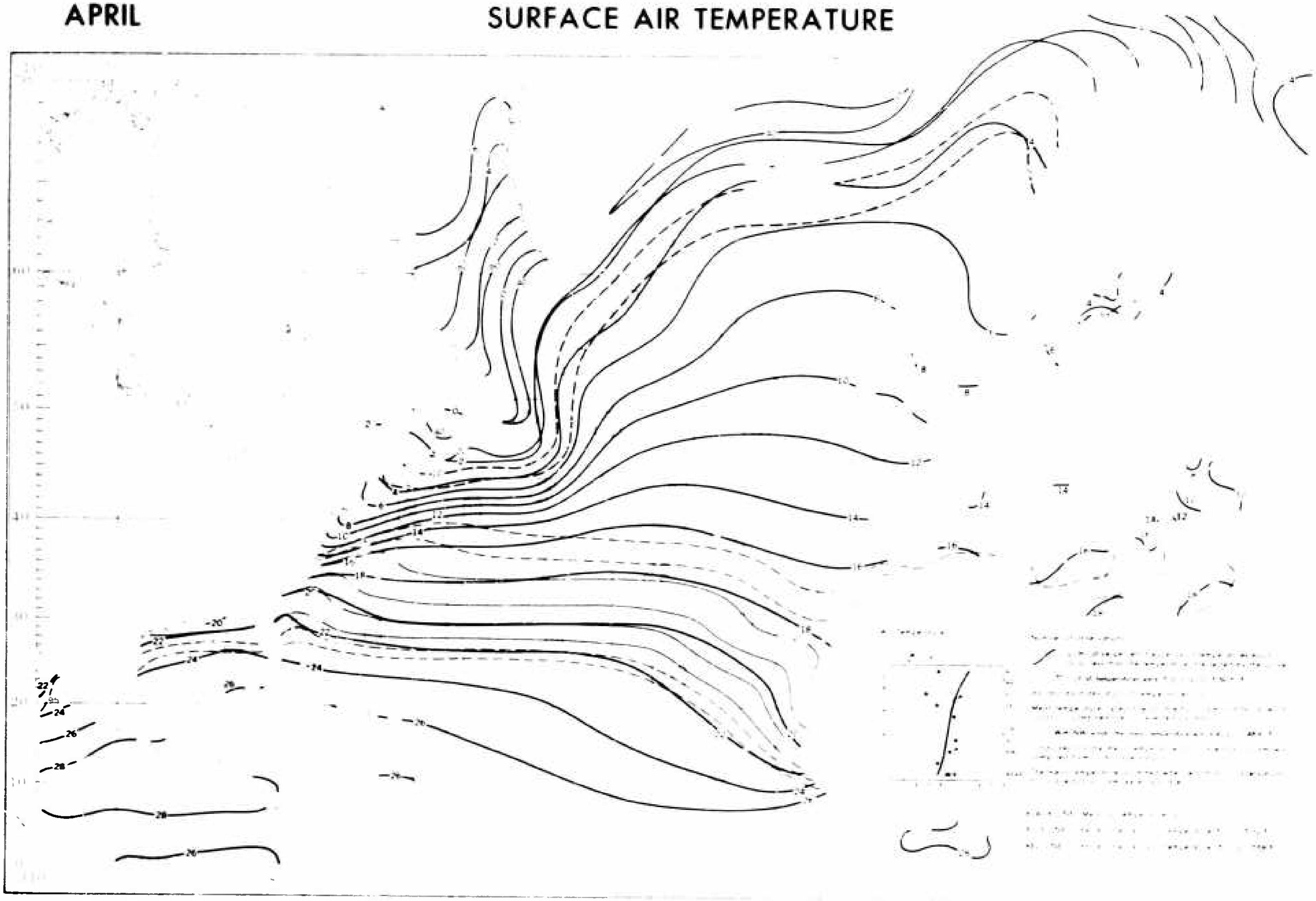
WIND DIRECTION AND SPEED

APRIL



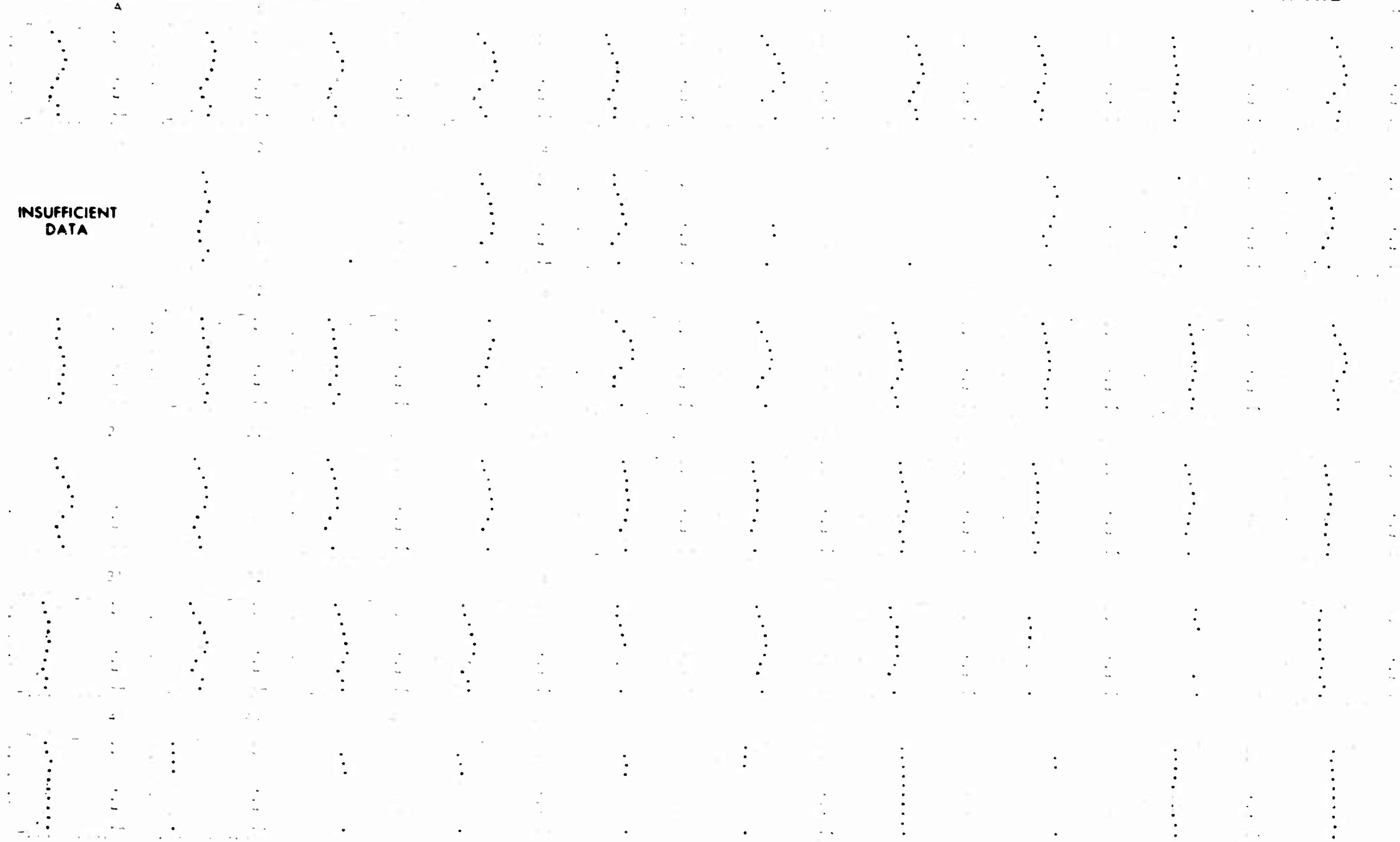
APRIL

SURFACE AIR TEMPERATURE

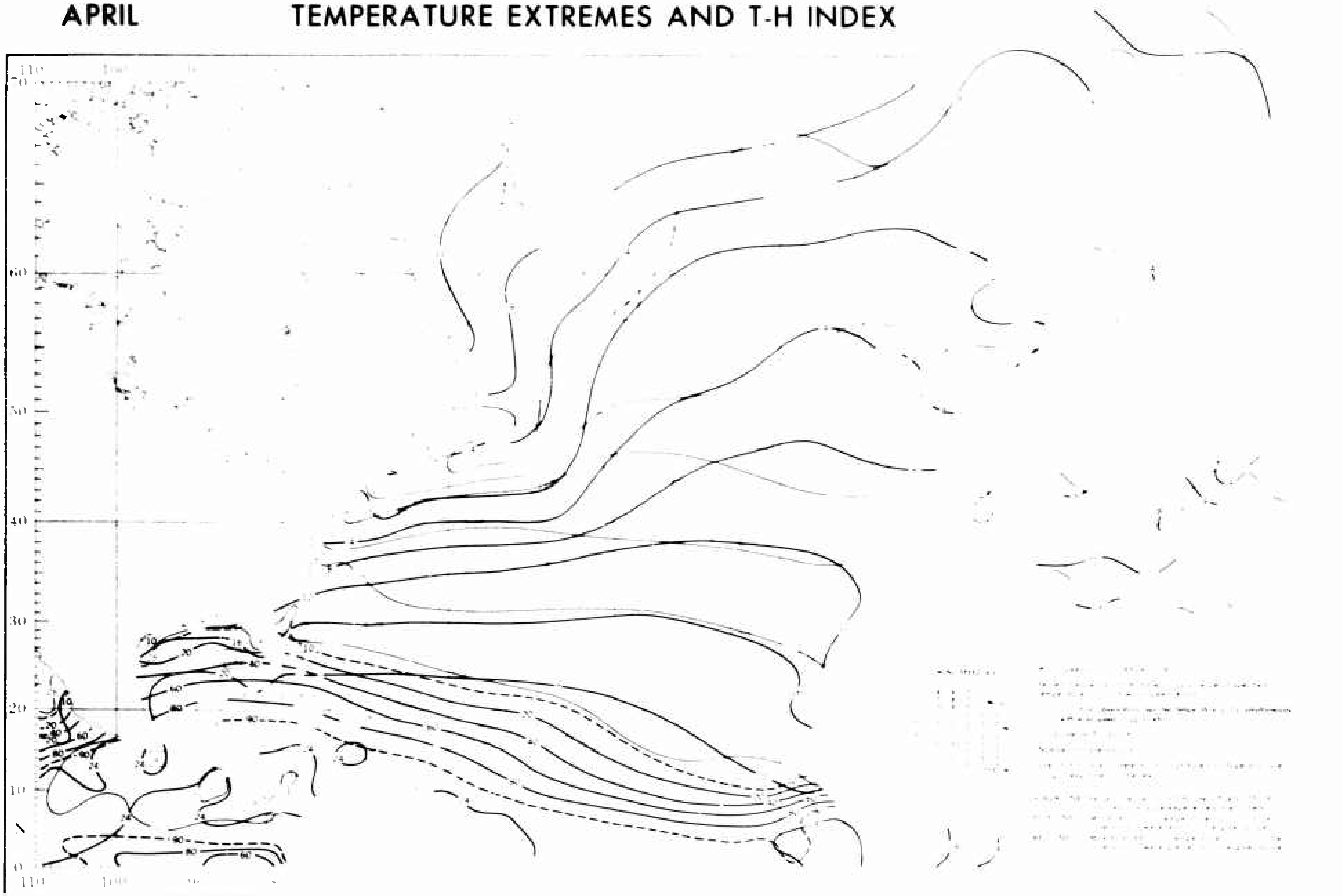


SURFACE AIR TEMPERATURE

APRIL



TEMPERATURE EXTREMES AND T-H INDEX



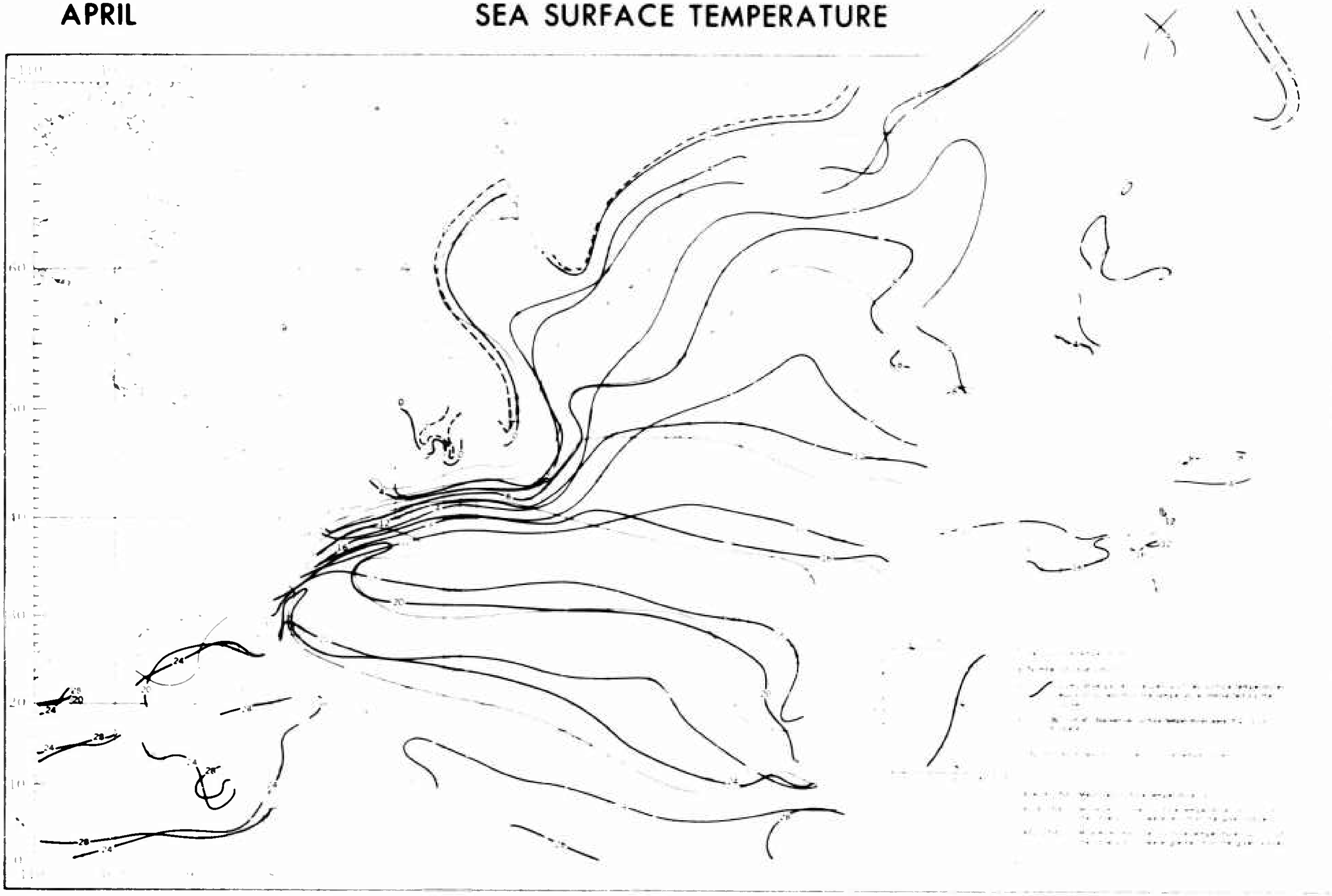
WIND SPEED AND AIR TEMPERATURE

APRIL

INSUFFICIENT
DATA

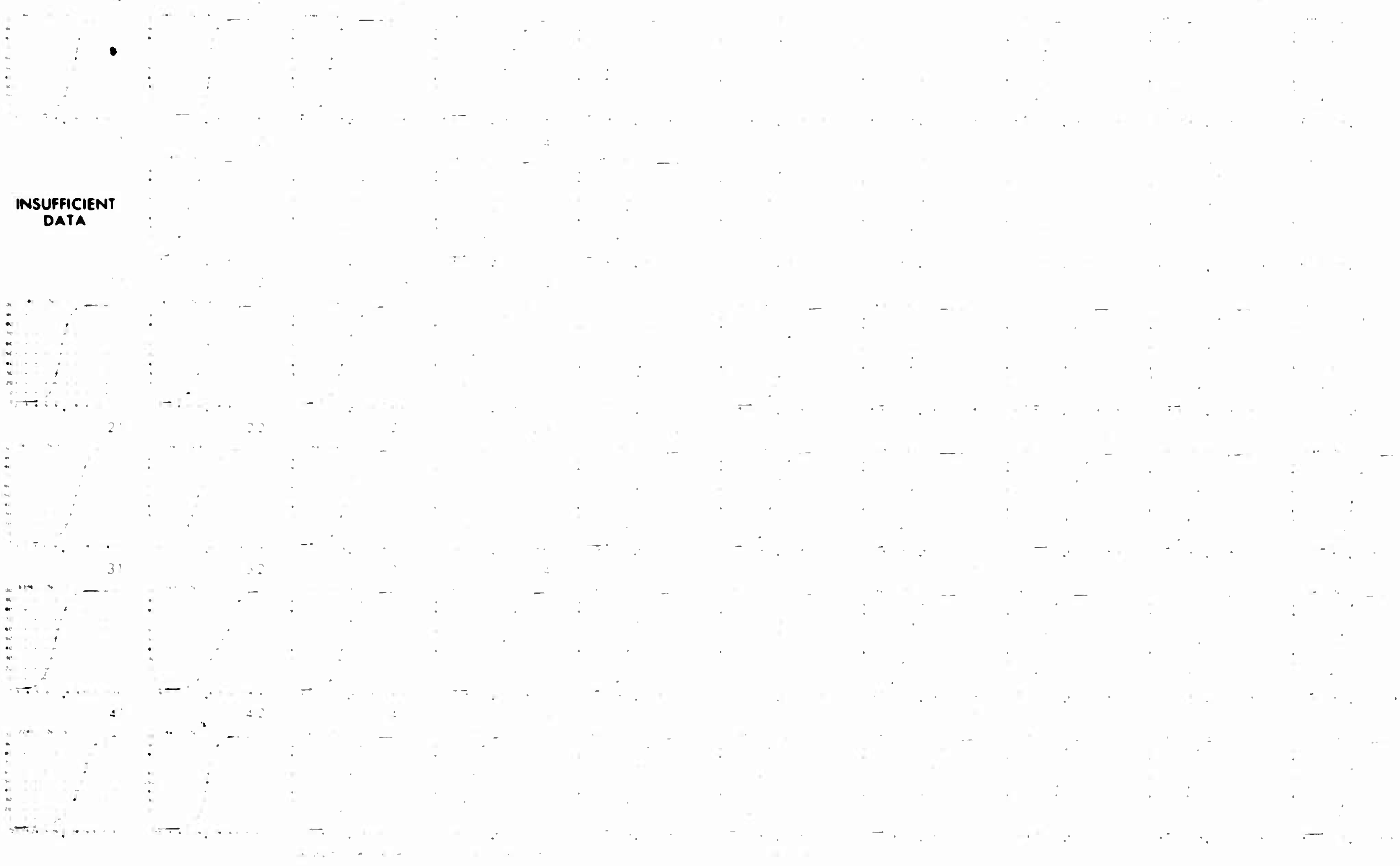
APRIL

SEA SURFACE TEMPERATURE

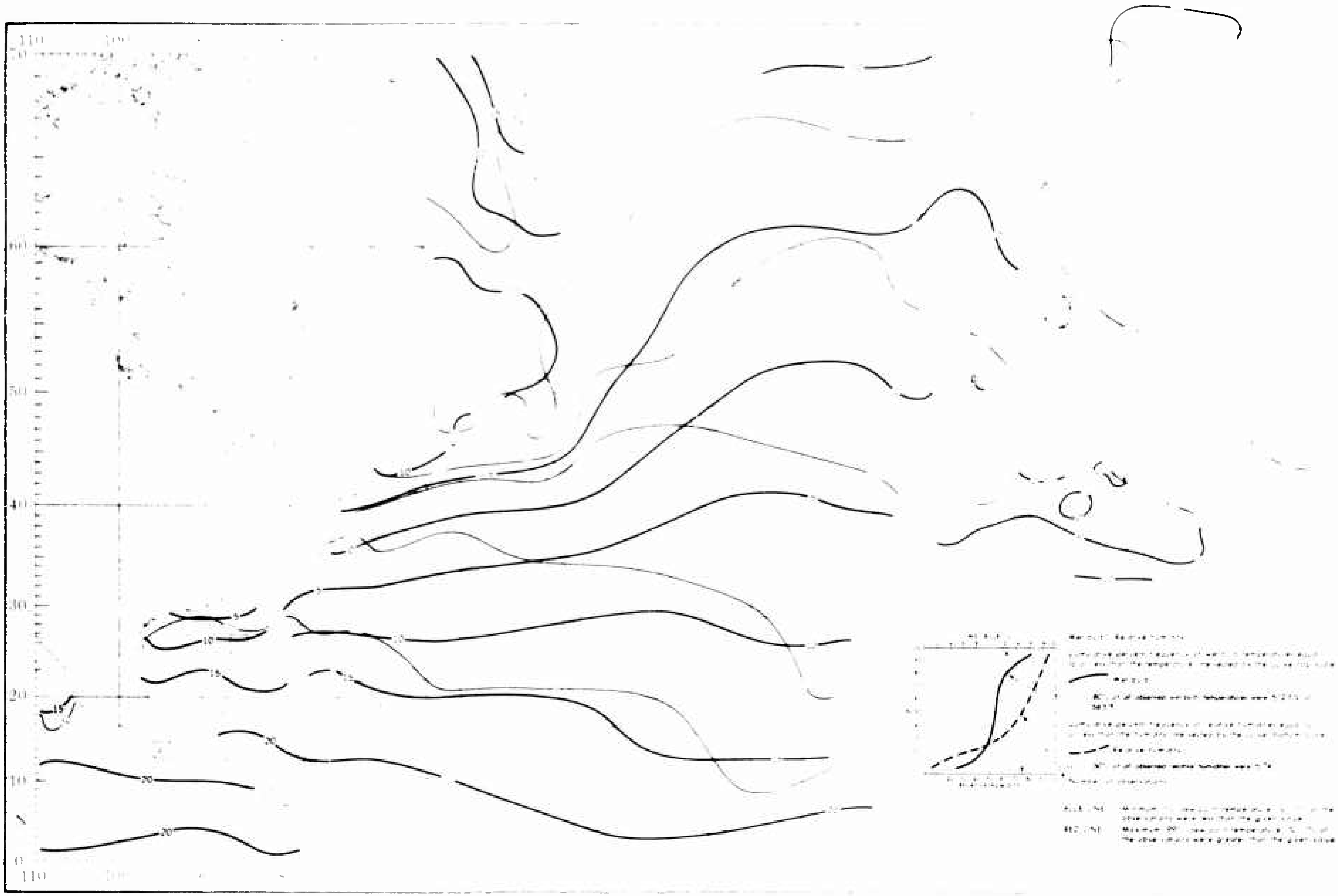


SEA SURFACE TEMPERATURE

APRIL

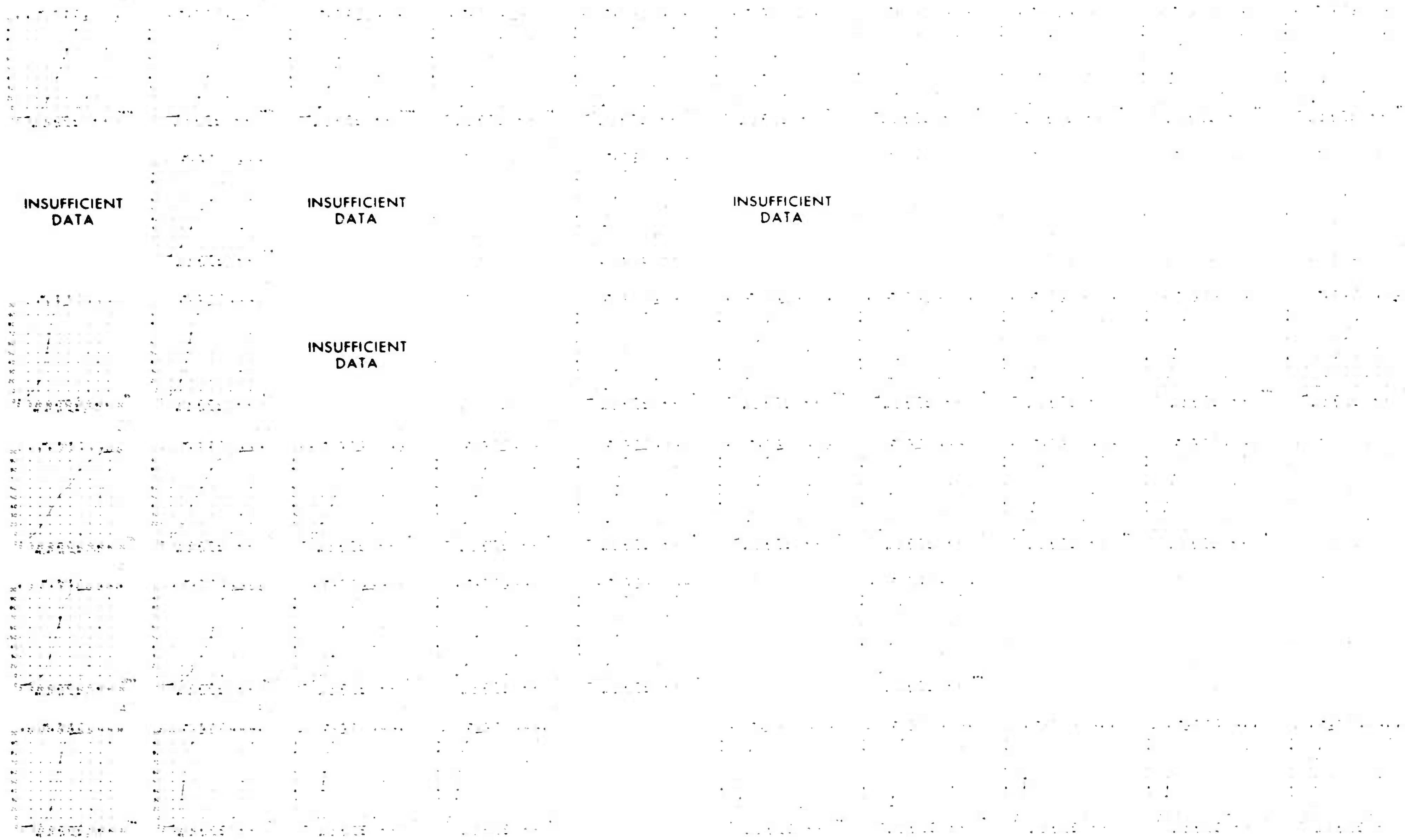


APRIL HUMIDITY

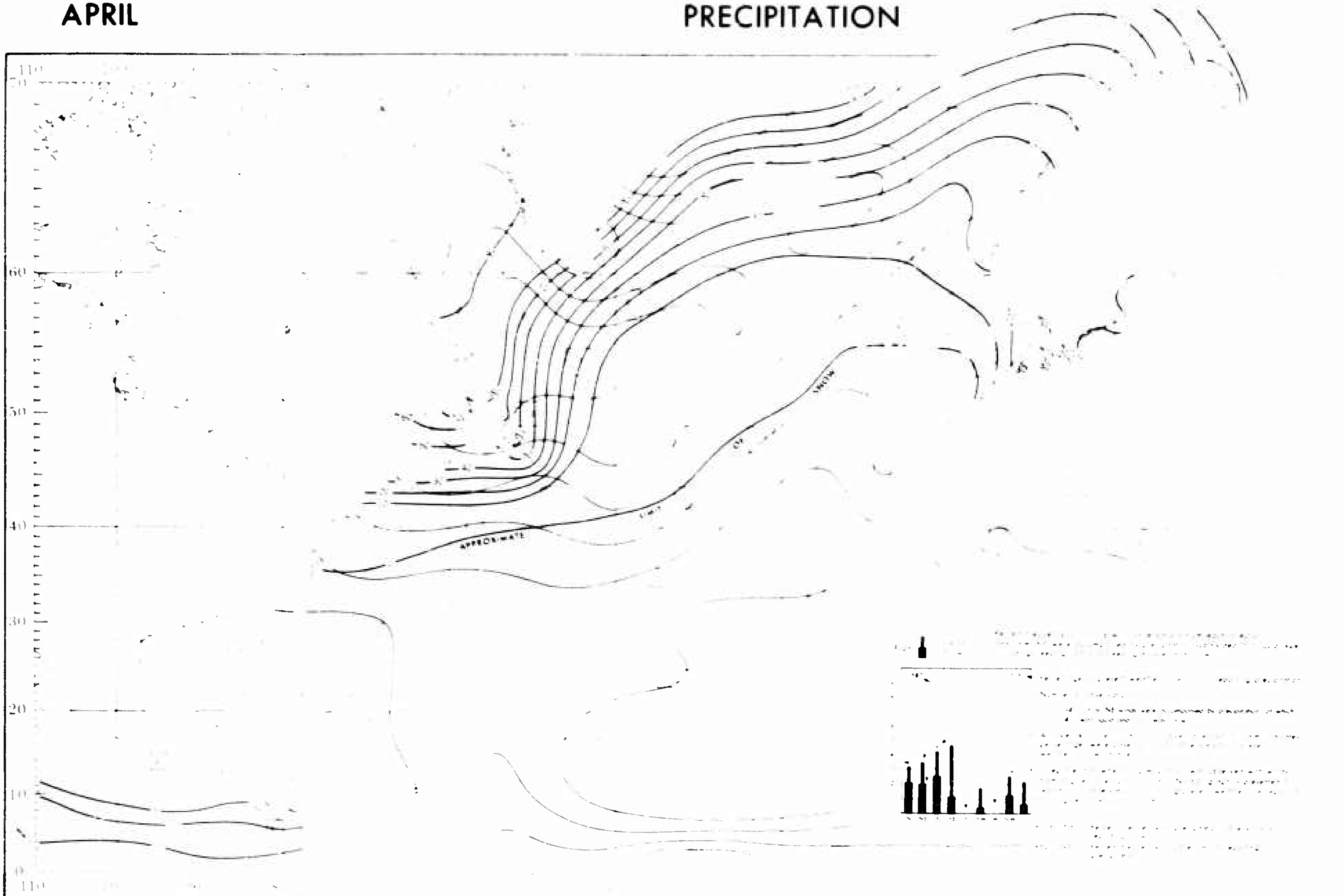


WET BULB AND RELATIVE HUMIDITY

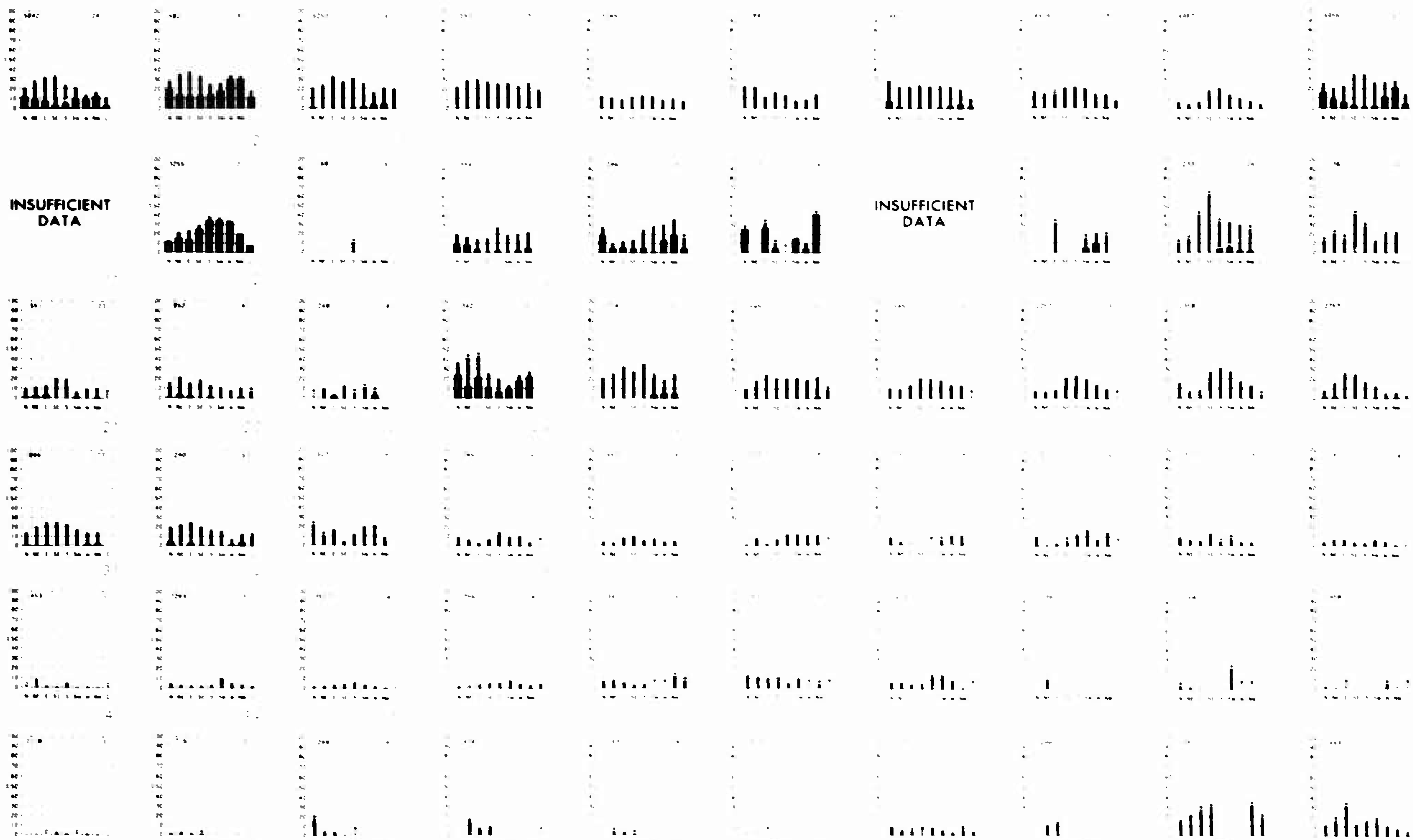
APRIL



APRIL PRECIPITATION

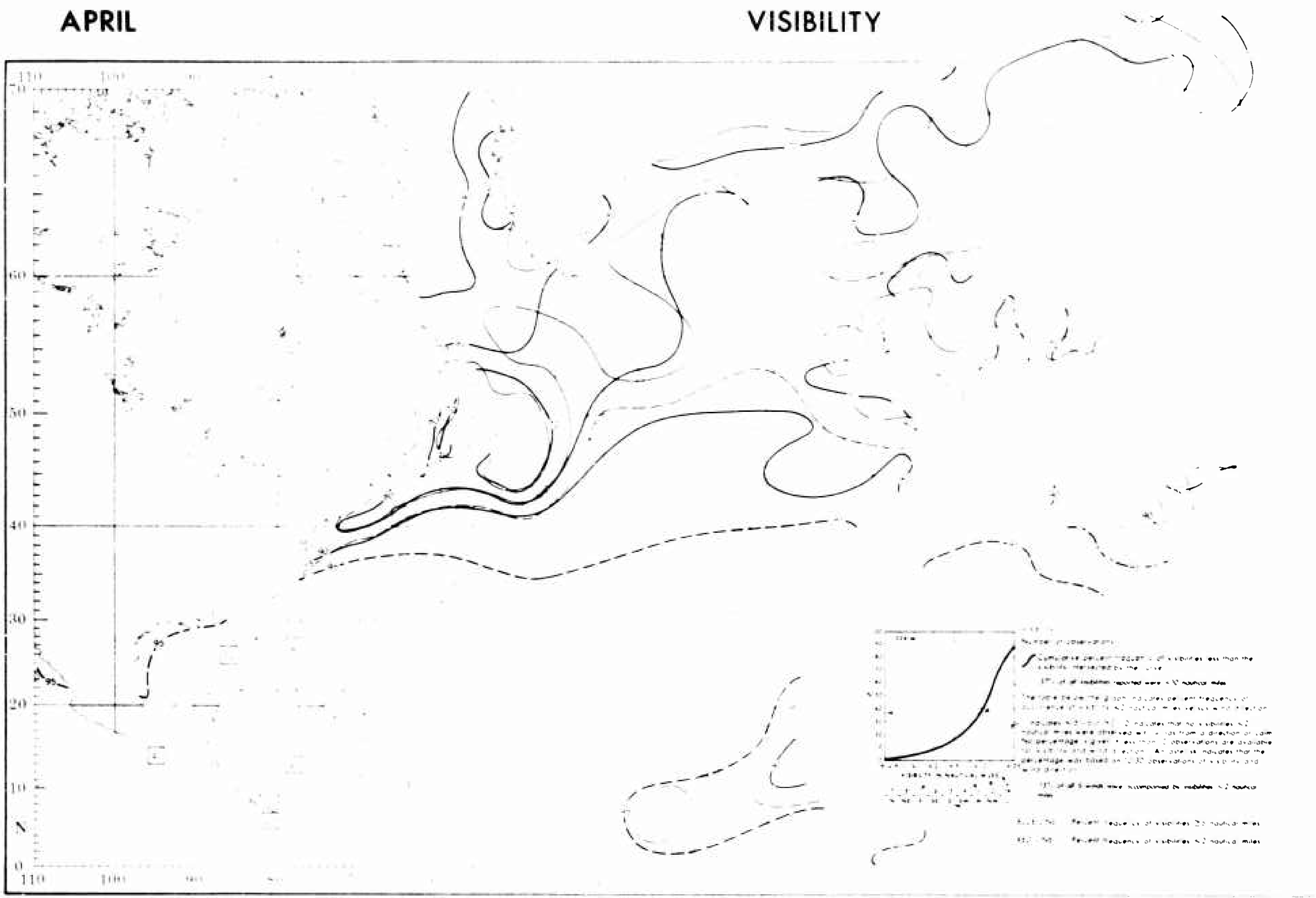


PRECIPITATION APRIL



APRIL

VISIBILITY

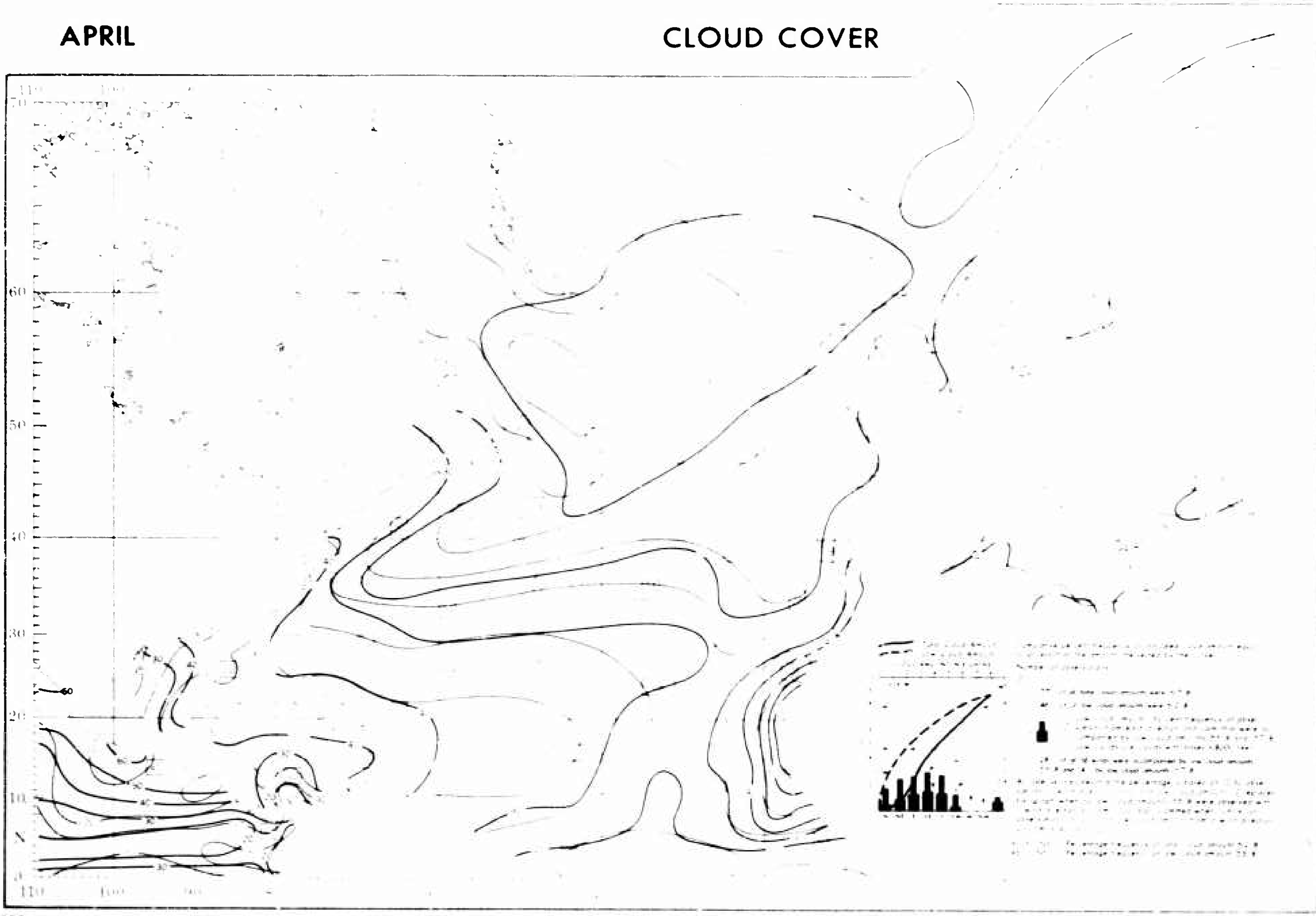


VISIBILITY

APRIL

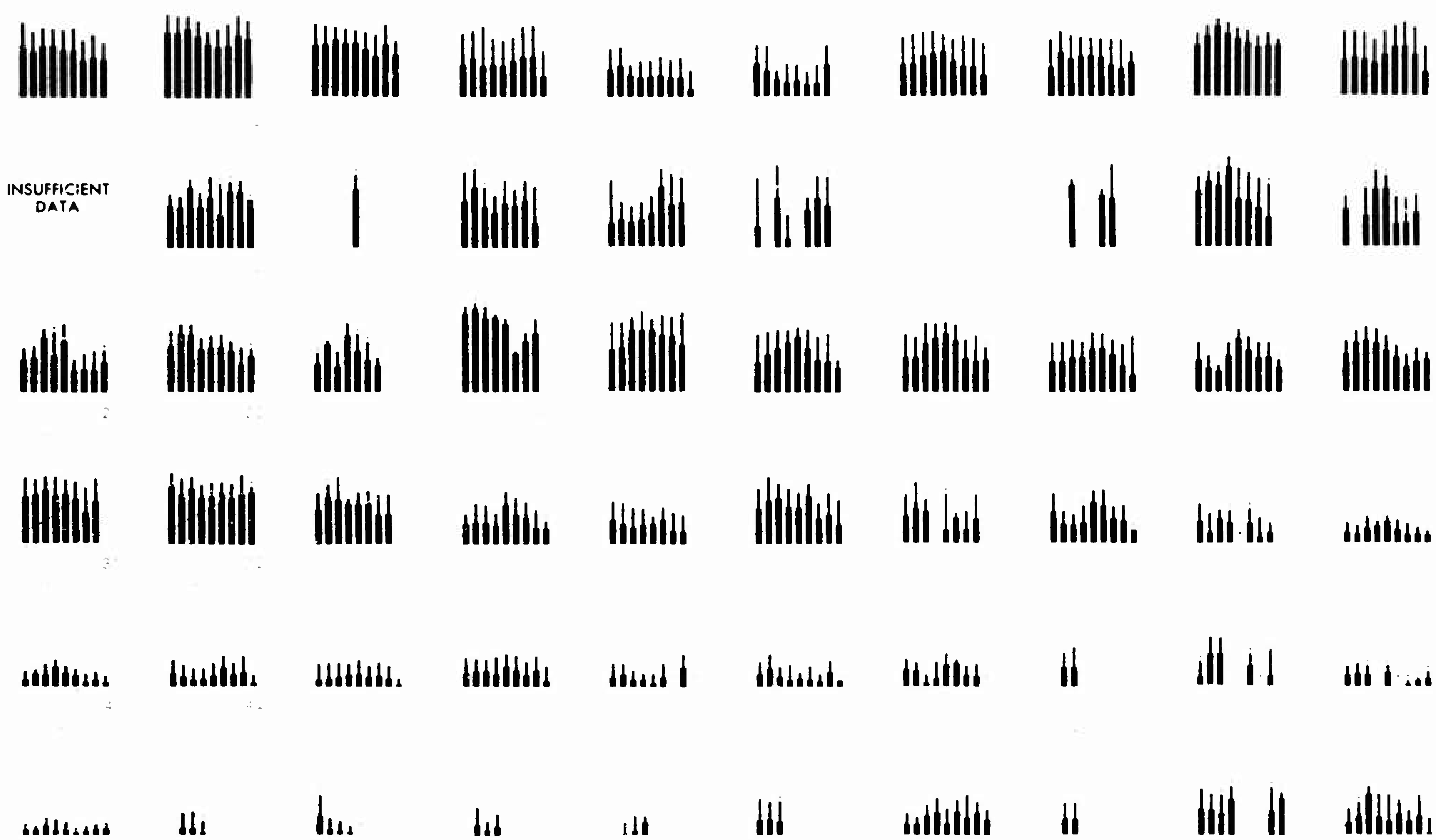
INSUFFICIENT DATA

APRIL CLOUD COVER

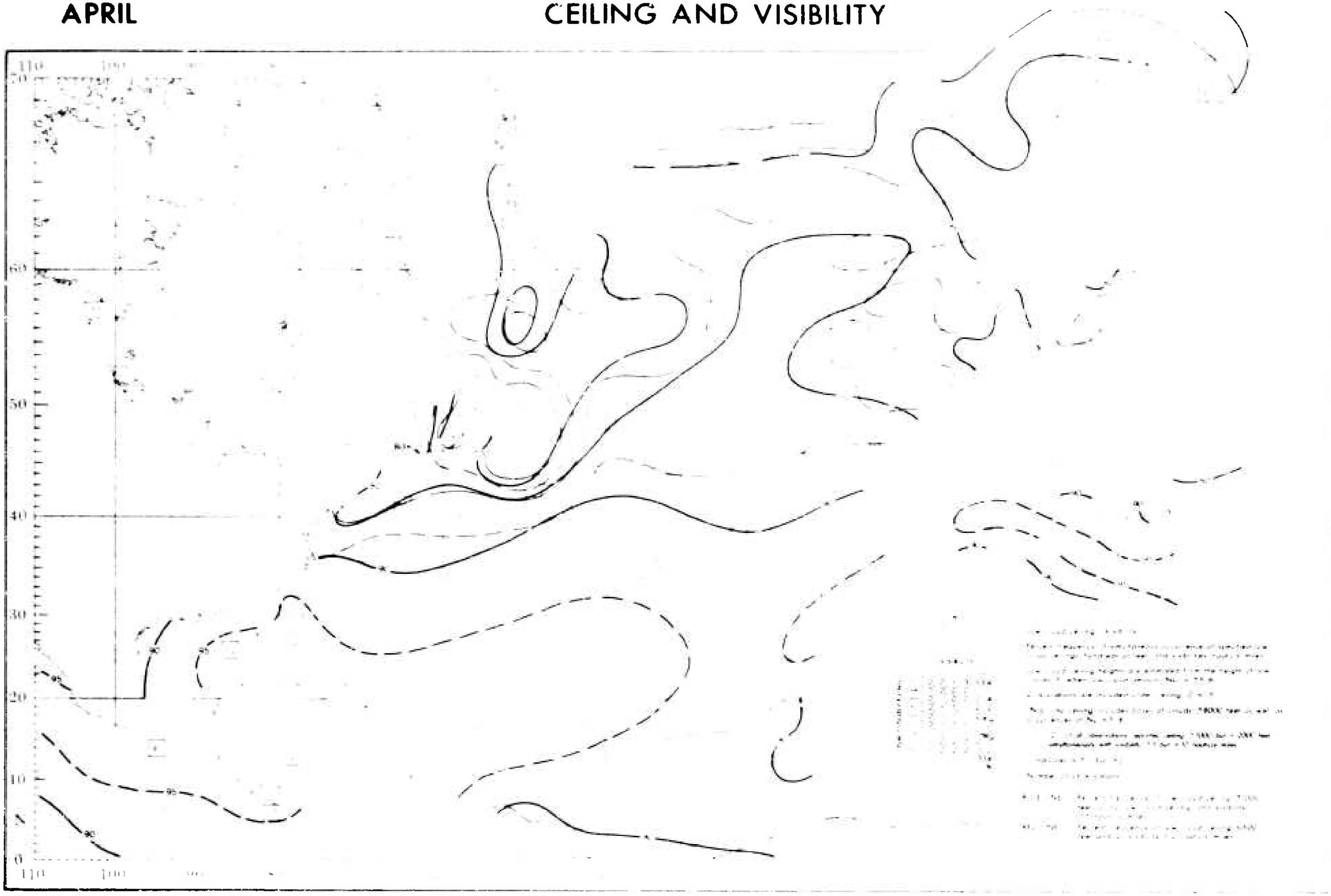


CLOUD COVER

APRIL



CEILING AND VISIBILITY



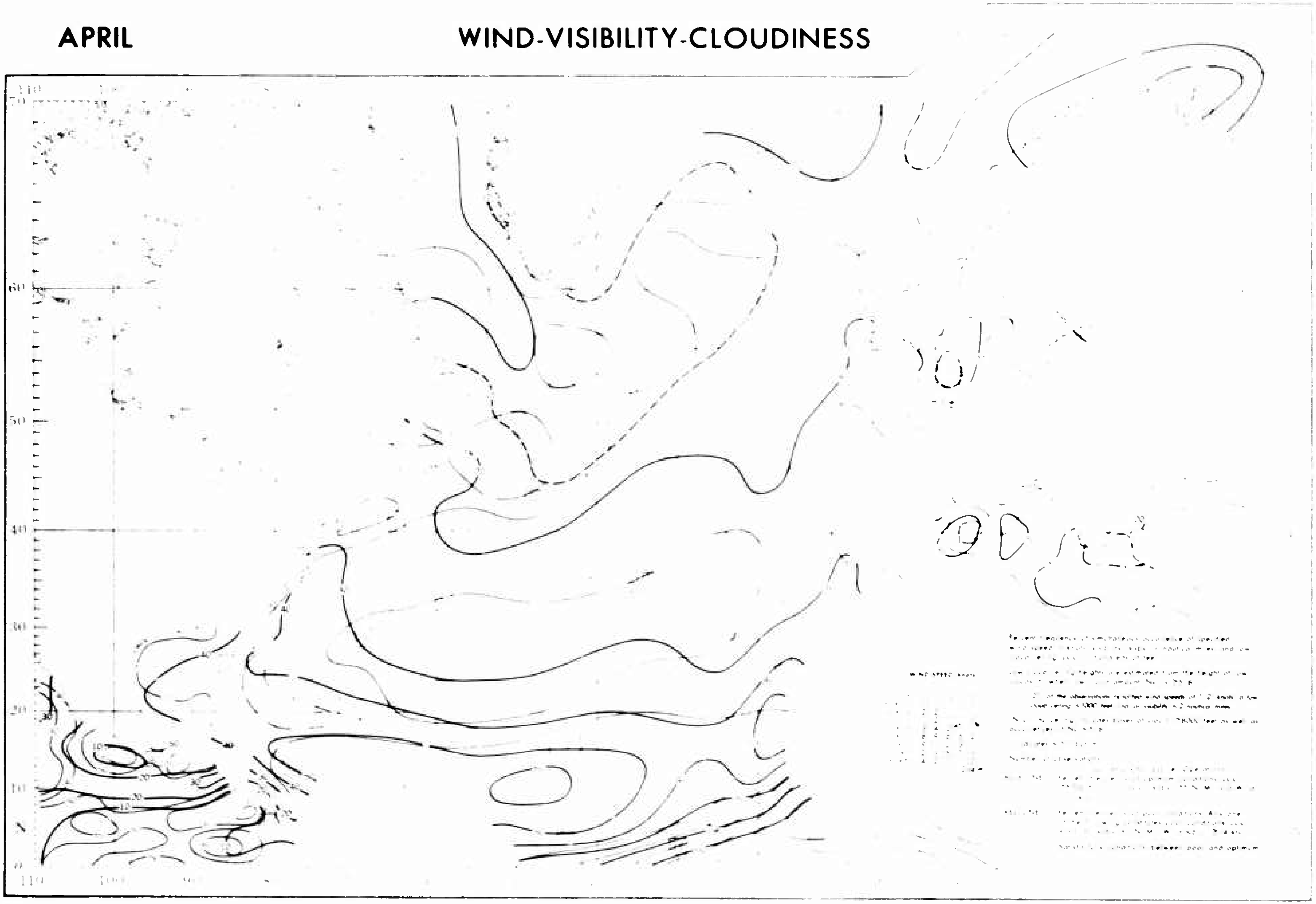
CEILING AND VISIBILITY

APRIL

INSUFFICIENT DATA

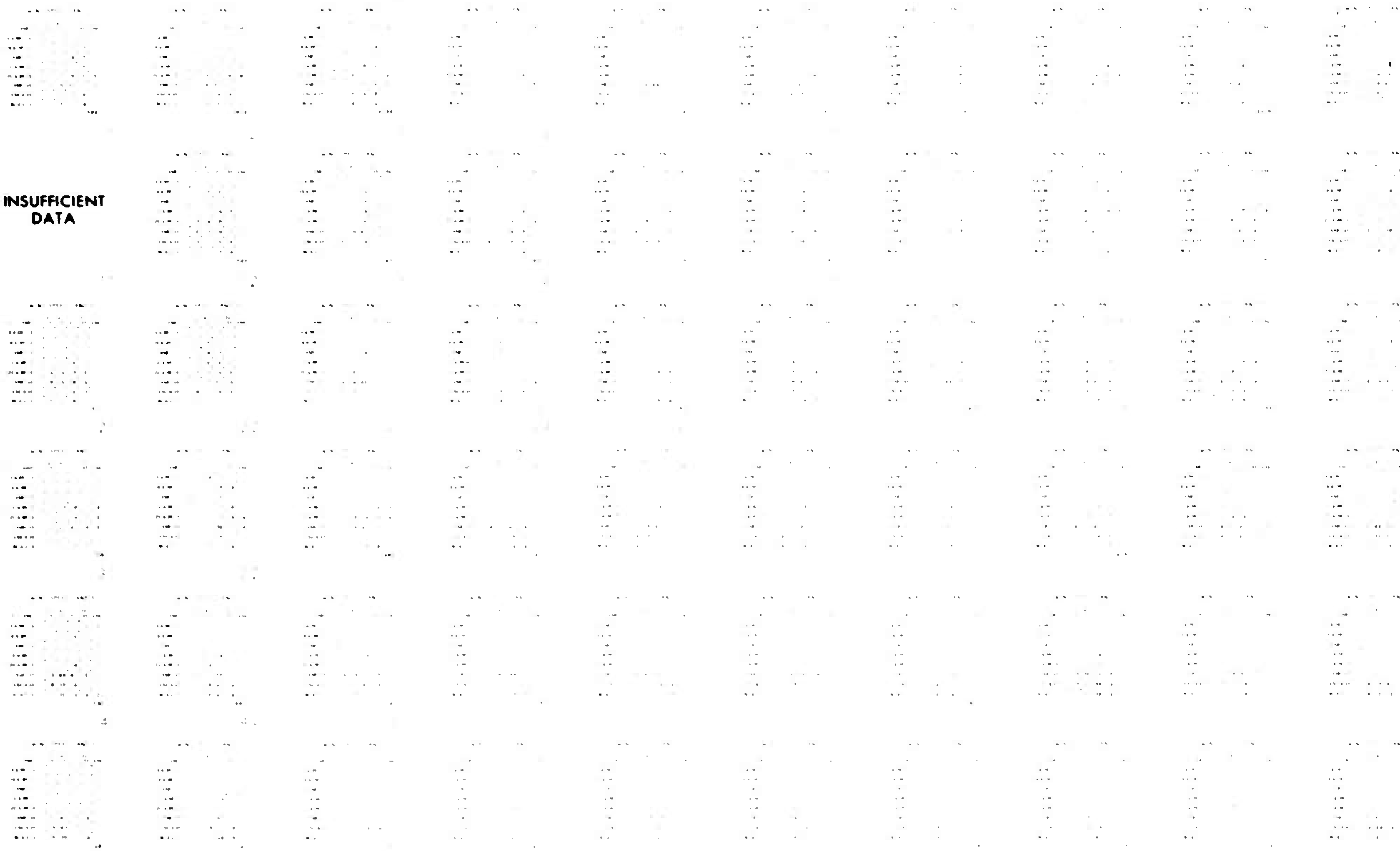
APRIL

WIND-VISIBILITY-CLOUDINESS



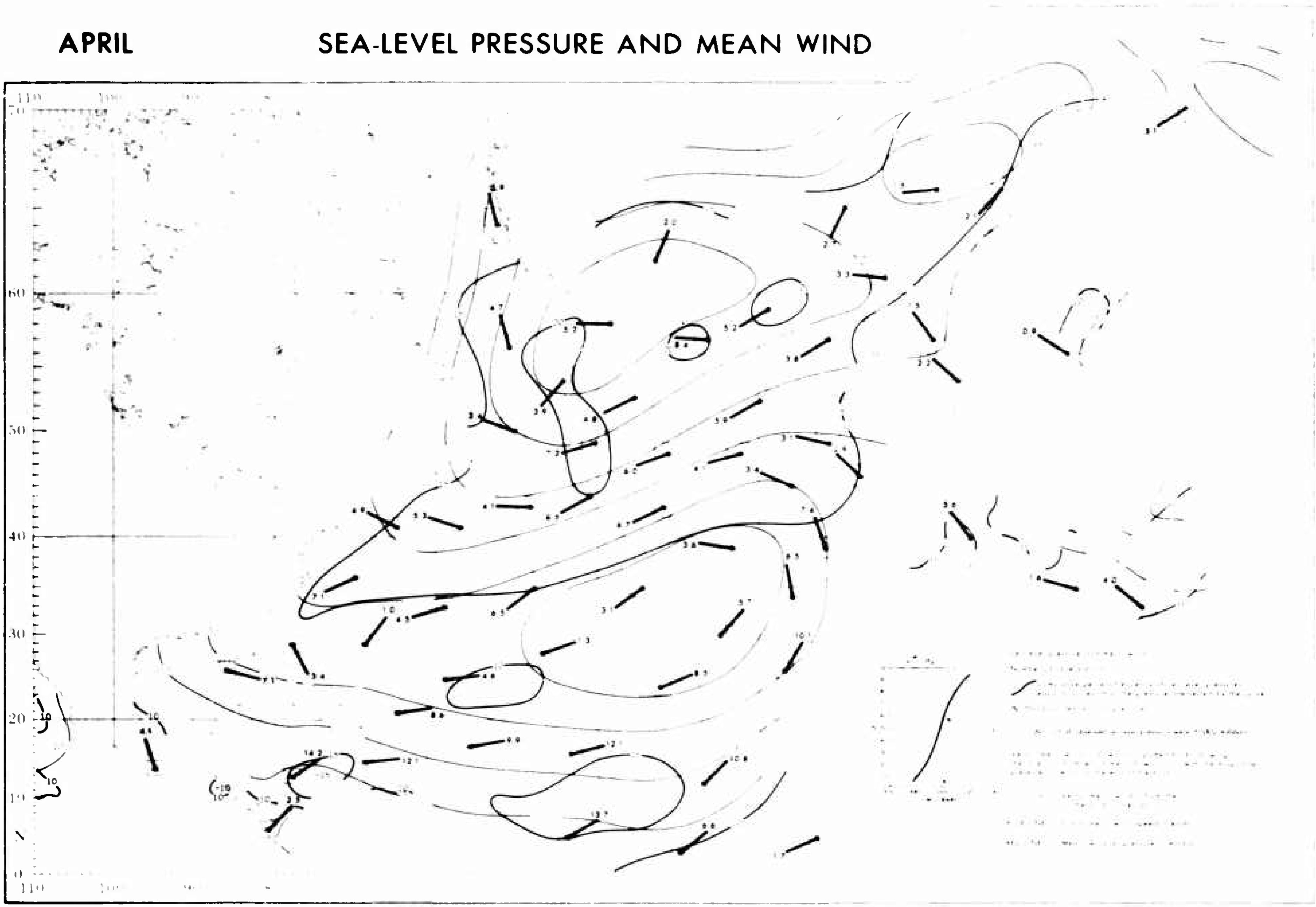
LOW CLOUD CEILING-VISIBILITY-WIND

APRIL



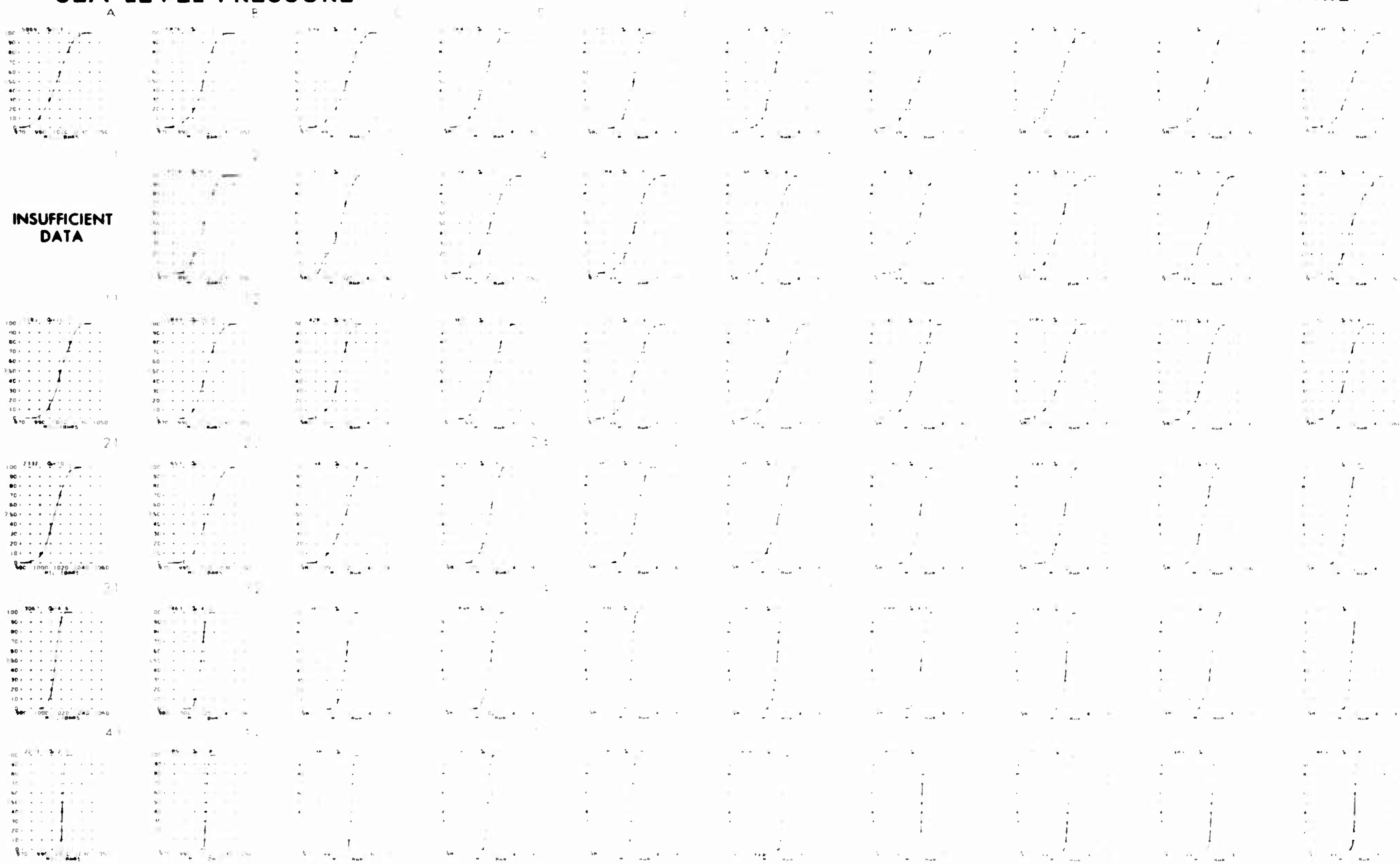
INSUFFICIENT DATA

APRIL SEA-LEVEL PRESSURE AND MEAN WIND

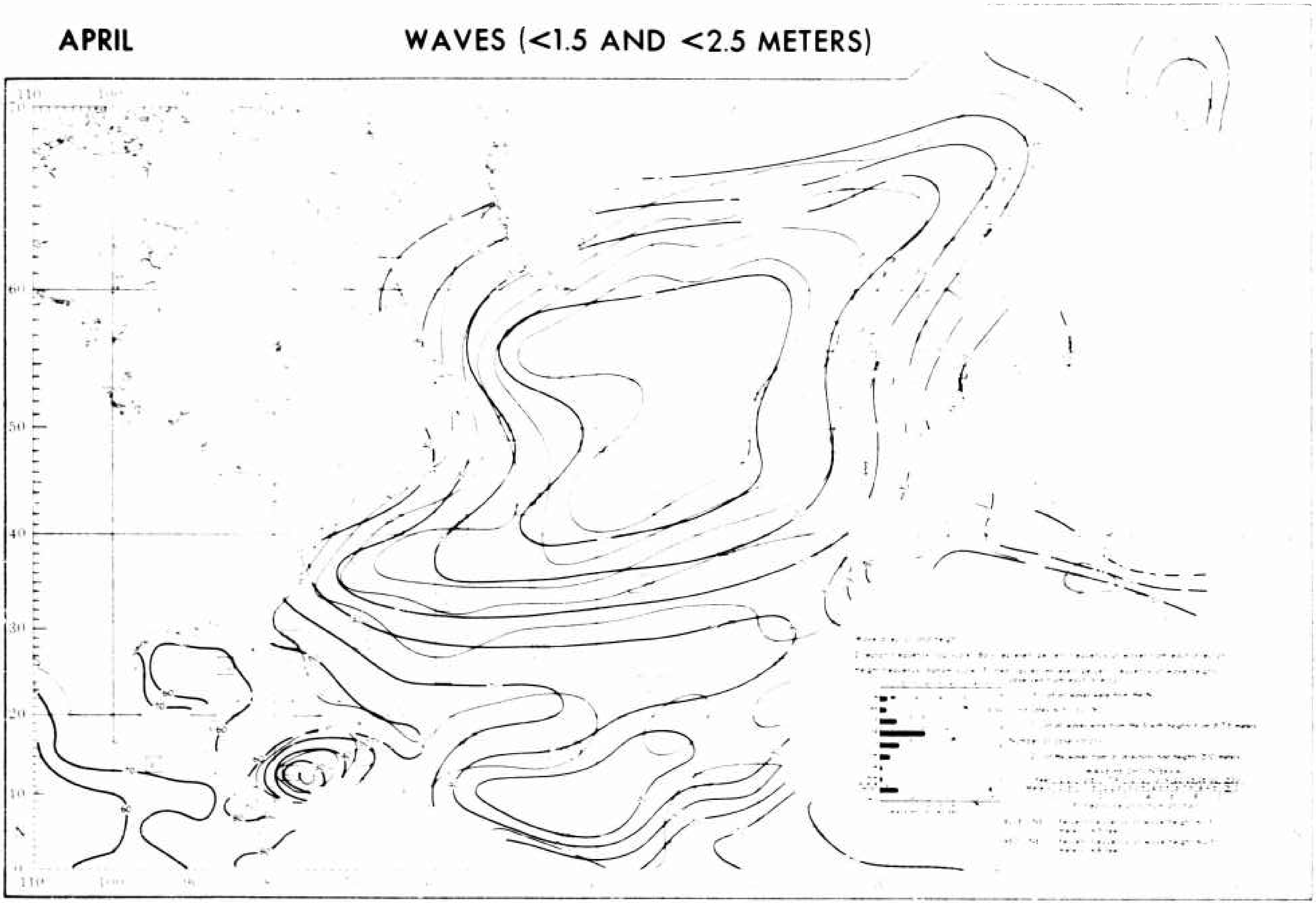


SEA LEVEL PRESSURE

APRIL

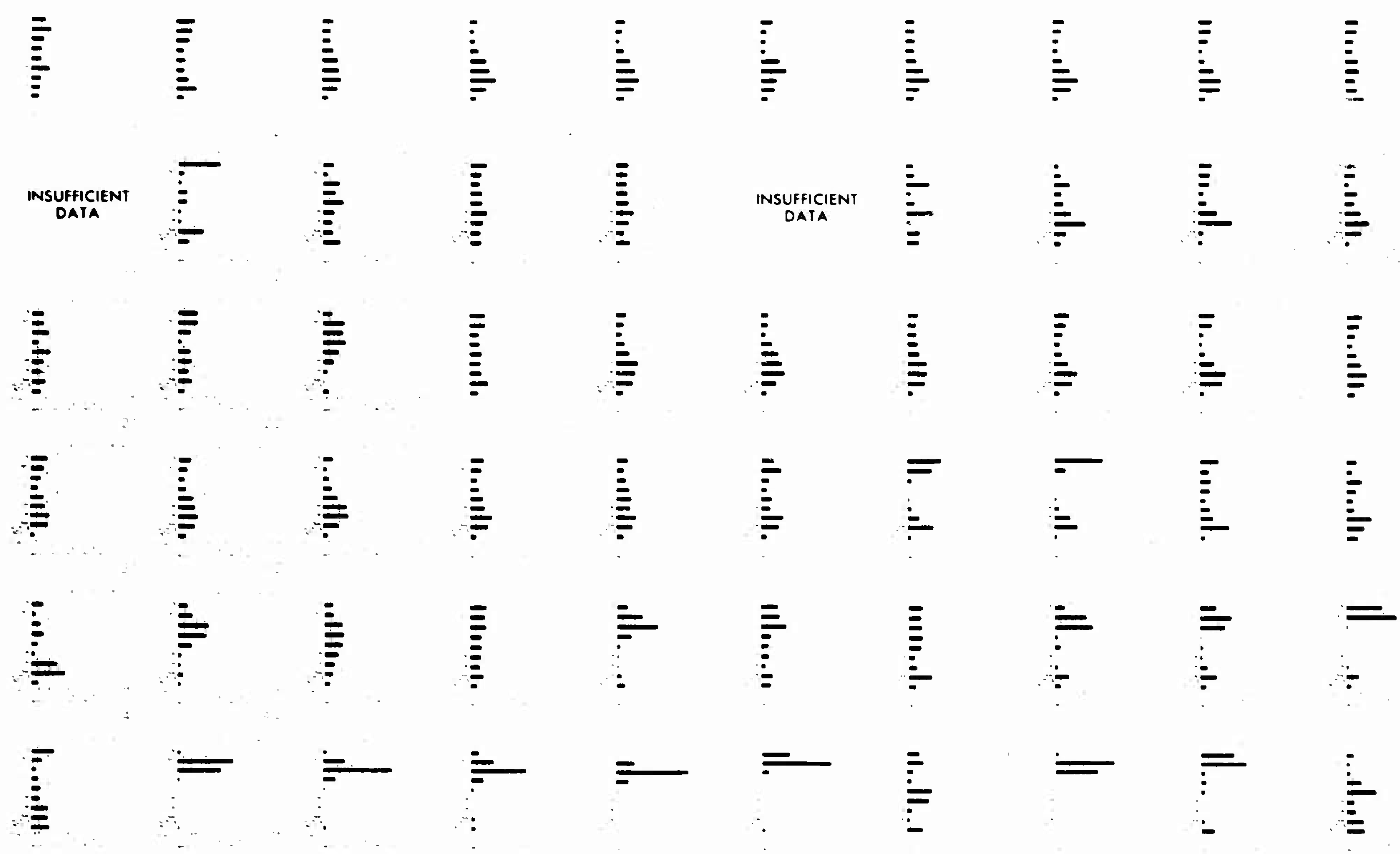


APRIL **WAVES (<1.5 AND <2.5 METERS)**



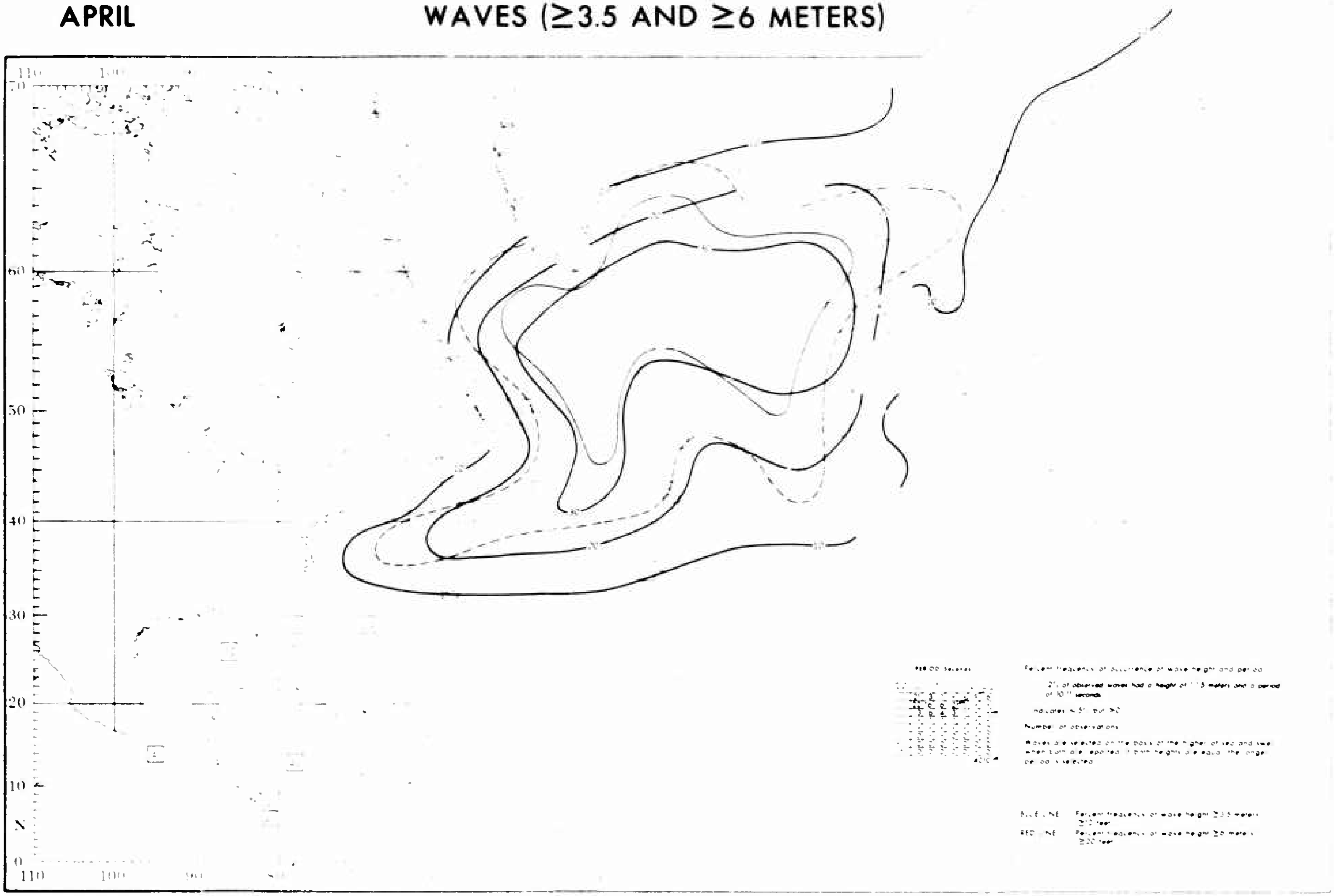
WAVE DIRECTION AND HEIGHT

APRIL



APRIL

WAVES (≥3.5 AND ≥6 METERS)



WAVE PERIOD AND HEIGHT

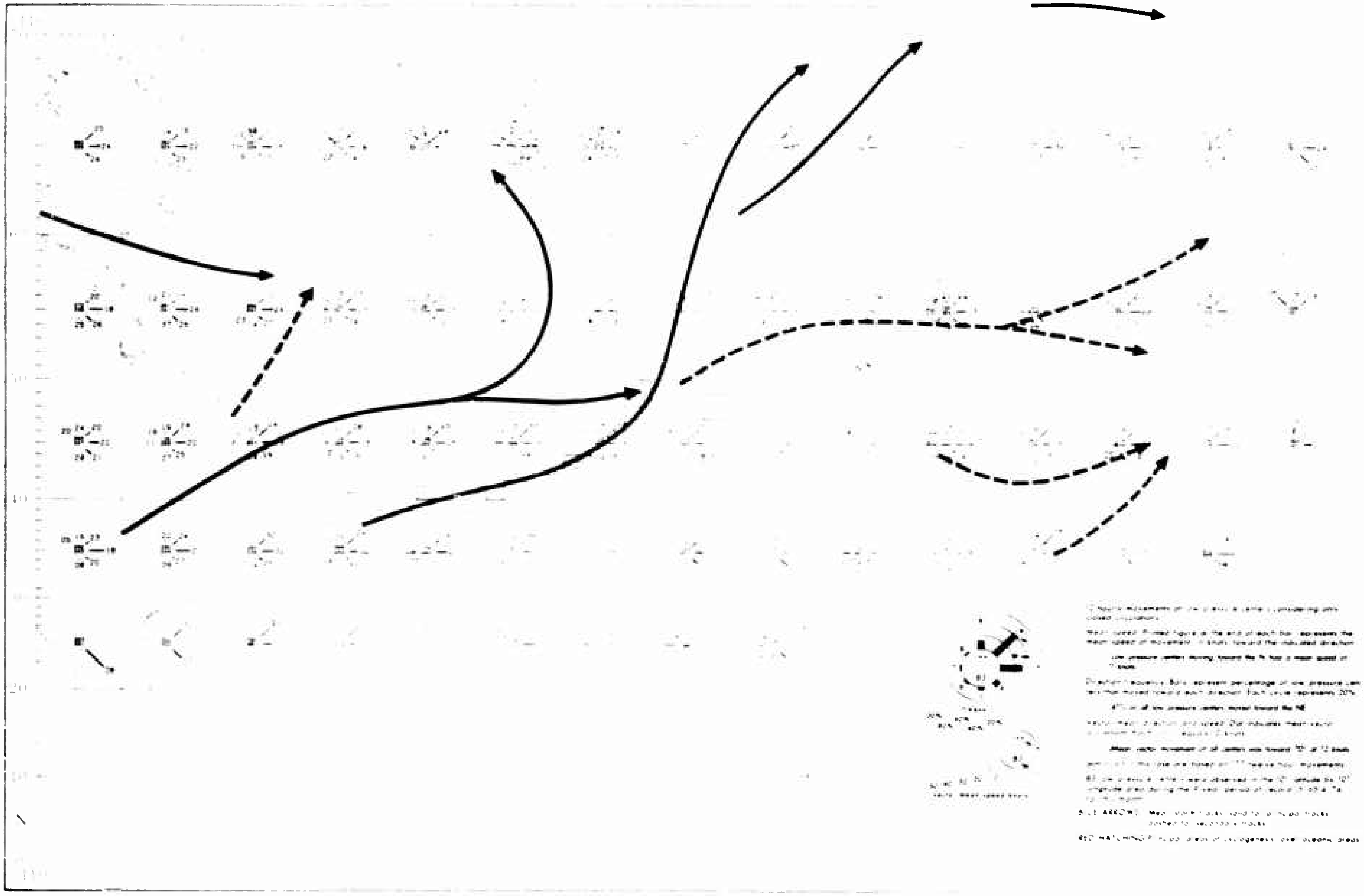
APRIL

INSUFFICIENT DATA

INSUFFICIENT DATA

APRIL

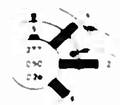
LOW PRESSURE CENTERS



TROPICAL CYCLONE

APRIL

12 hour's movements of tropical cyclone centers with tropical storm intensity or greater wind speed estimated ≥34 knots



Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

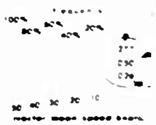
Centers moving toward the N had a mean speed of 5 knots.

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

35% of all tropical cyclones moved toward the NE.

Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

Mean vector movement of all centers was toward 75° at 7 knots.

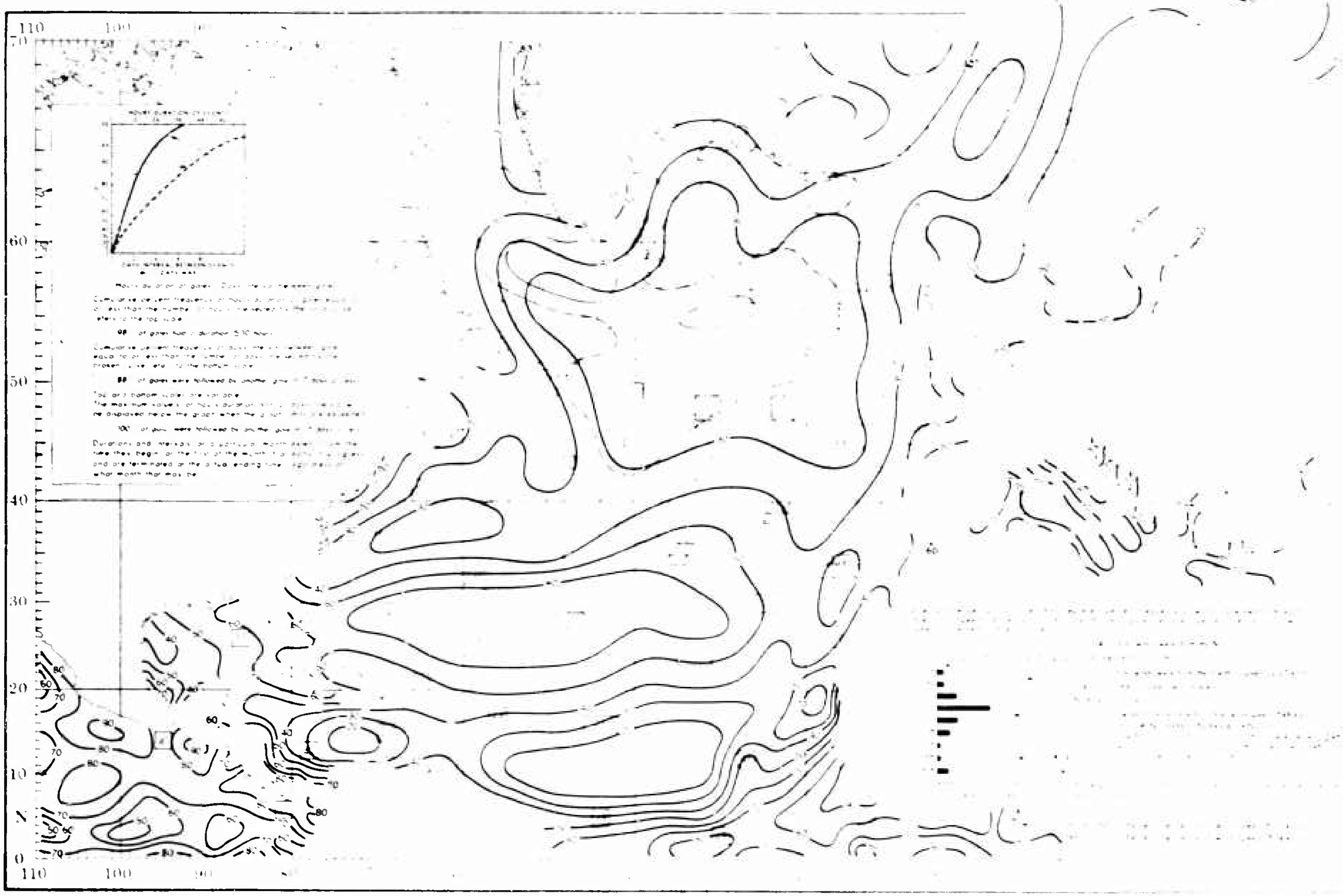


Statistics for this rose are based on 277 twelve hour movements.

50 individual storms were observed in the 5° X 5° area during the period of record.

Probability of having at least one tropical cyclone in this area in any given year for this month is 26%.

DATA NOT AVAILABLE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60
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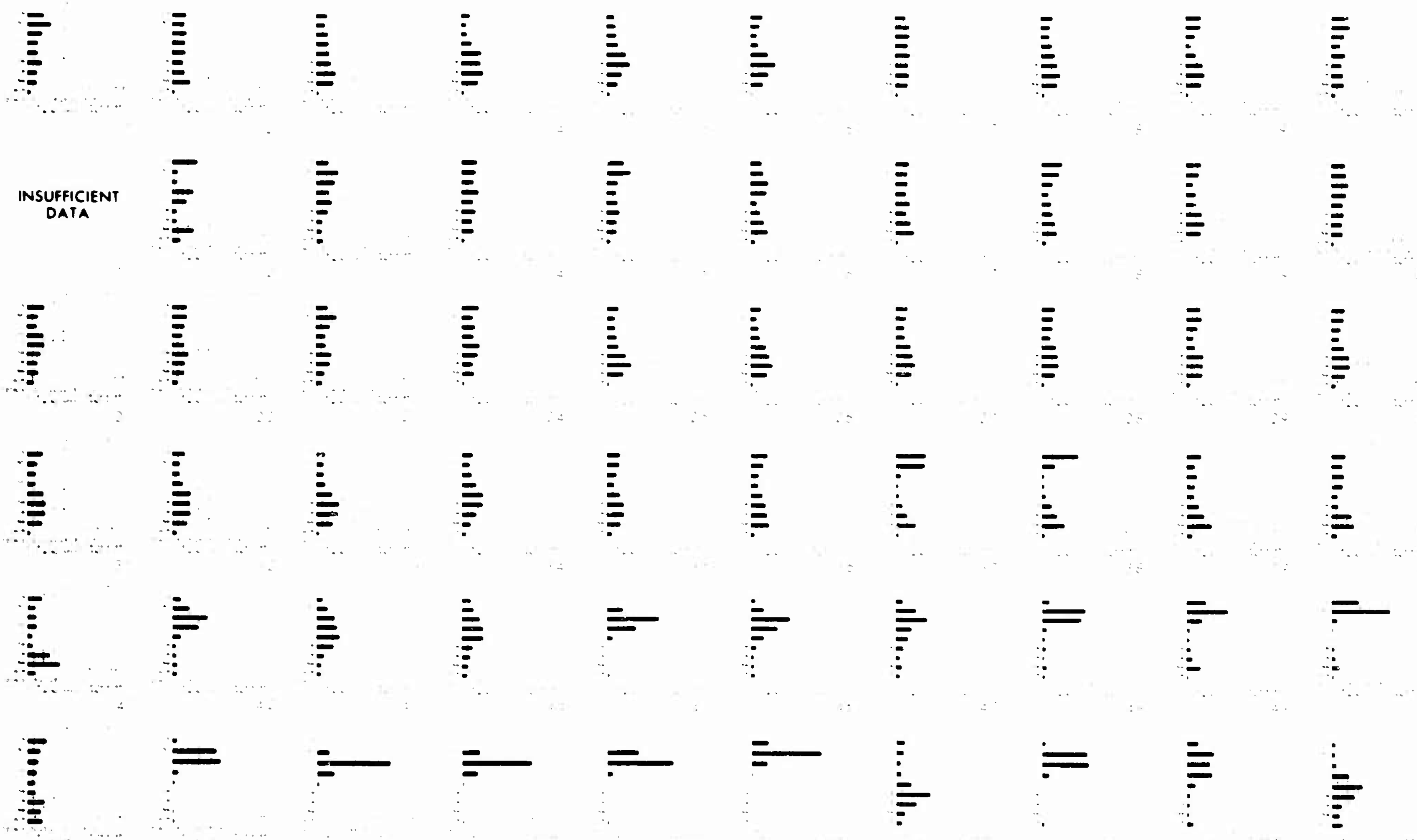
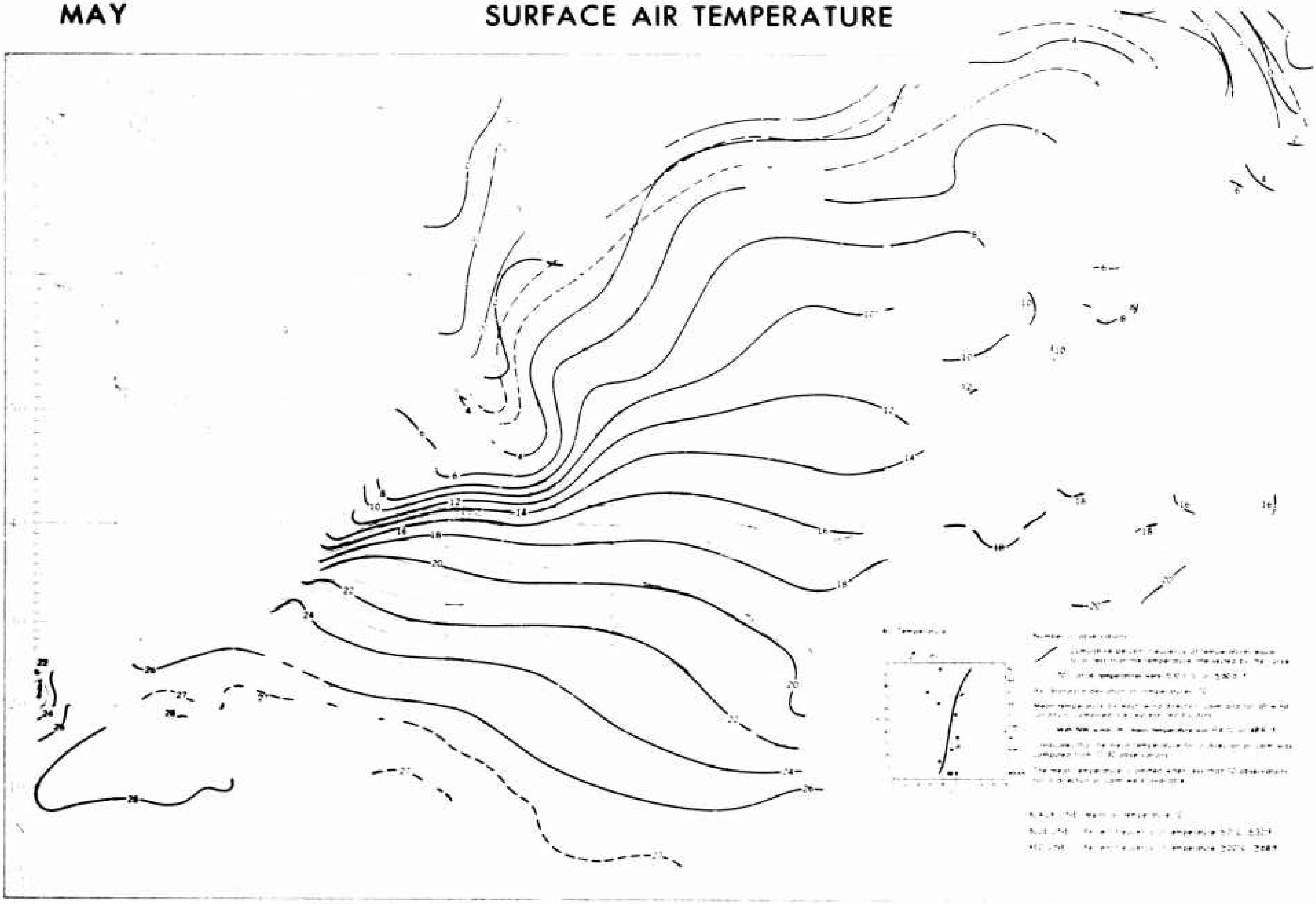
WIND DIRECTION AND SPEED

MAY



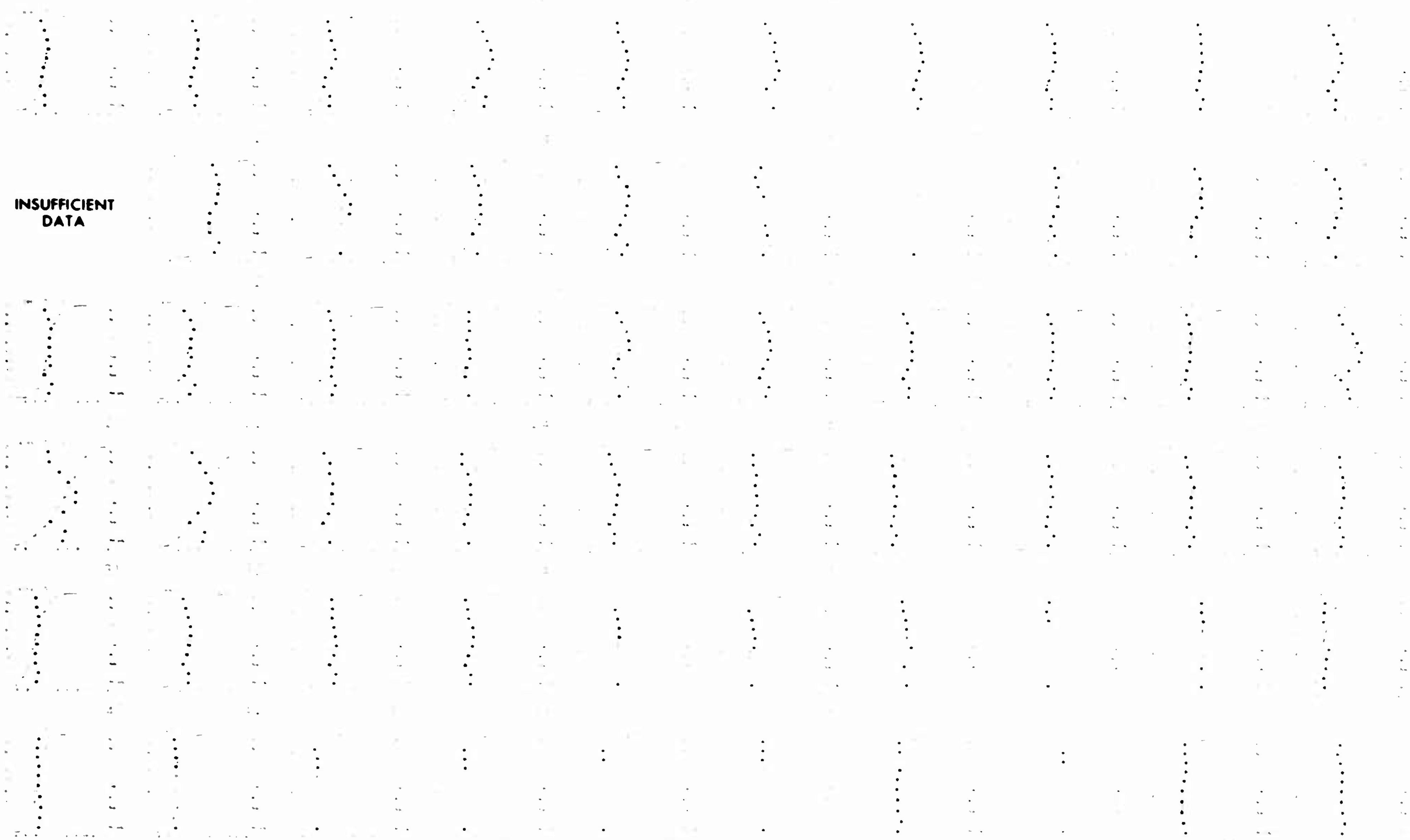
MAY

SURFACE AIR TEMPERATURE



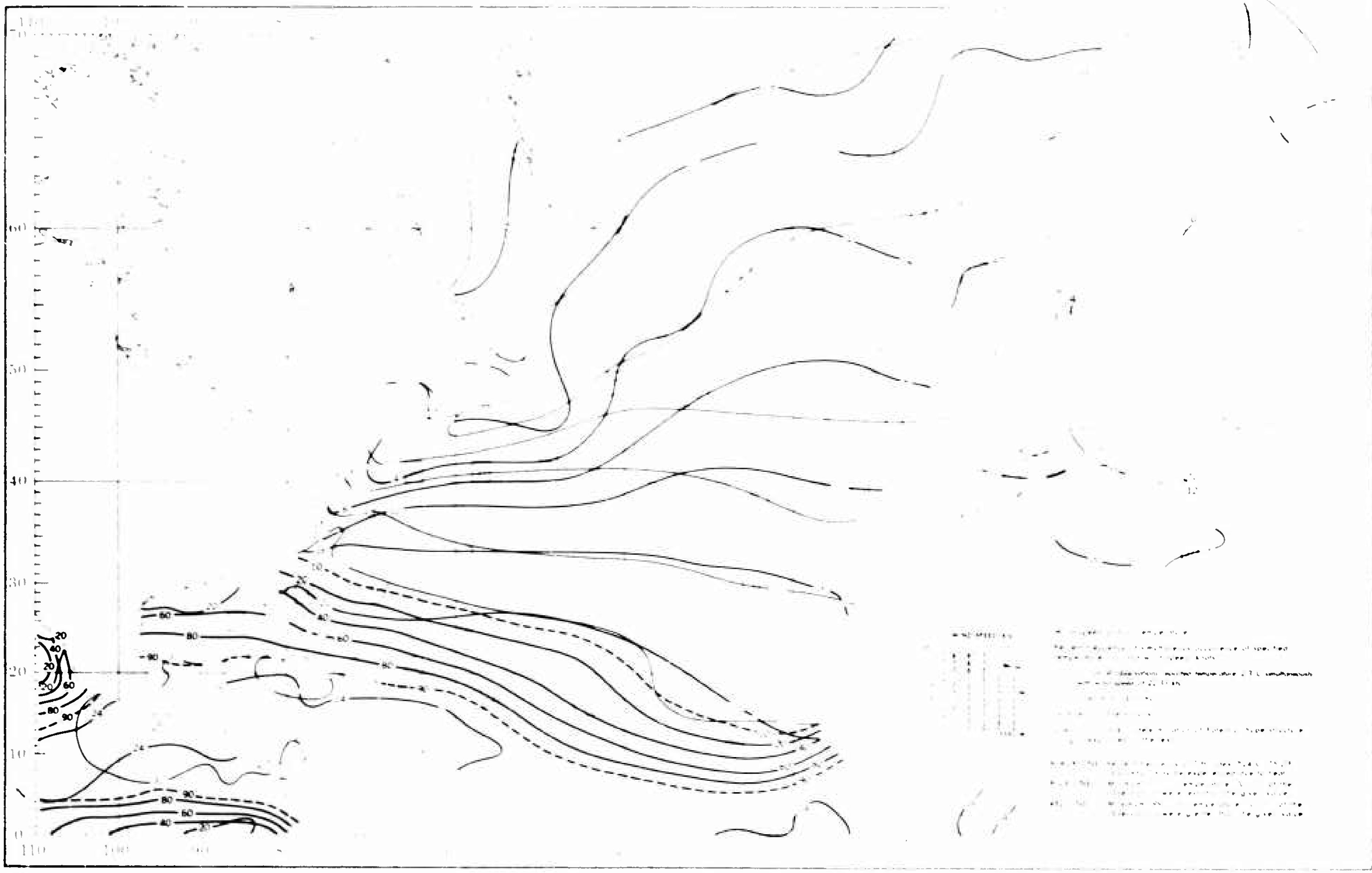
SURFACE AIR TEMPERATURE

MAY



MAY

TEMPERATURE EXTREMES AND T-H INDEX

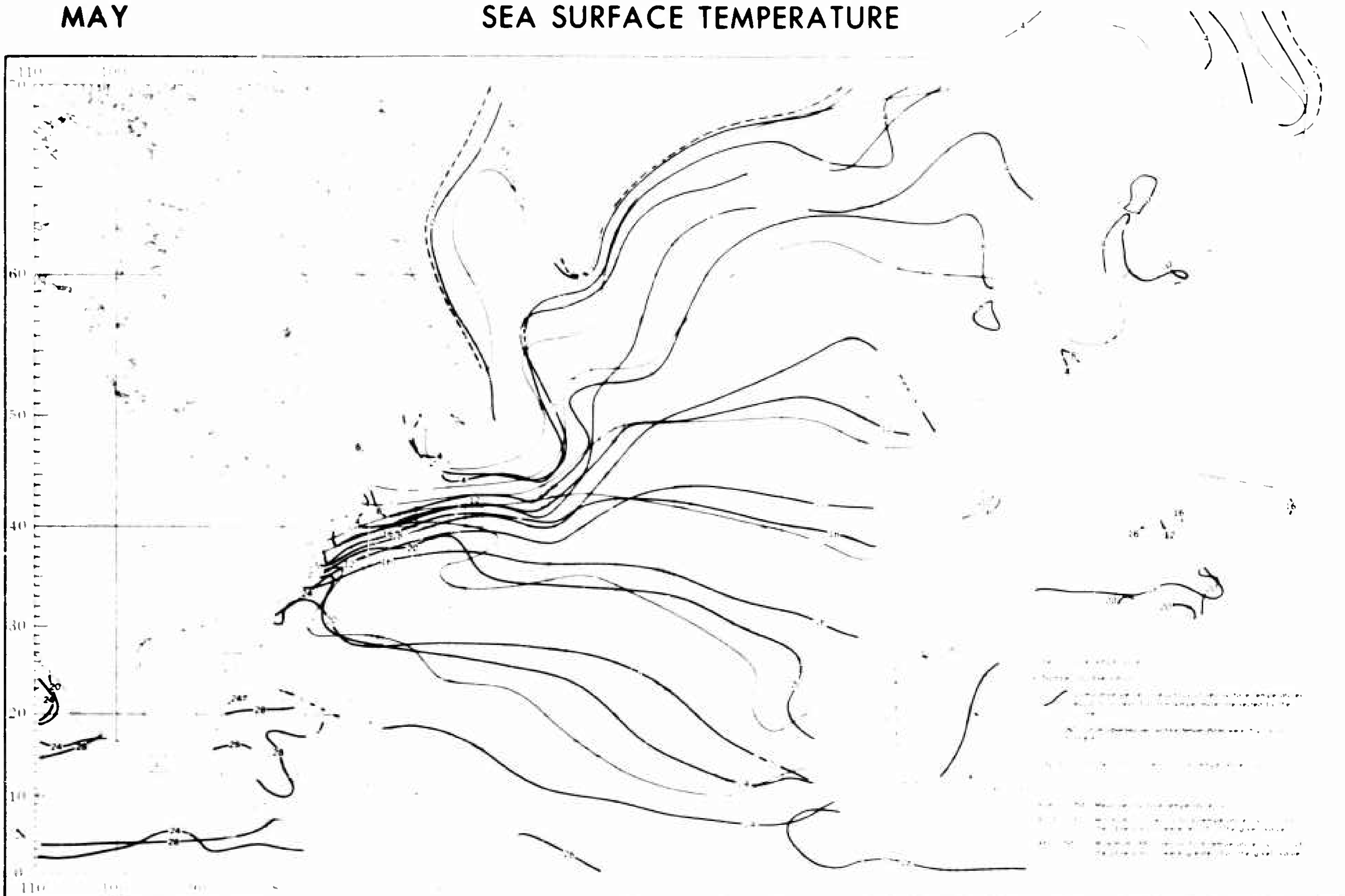


WIND SPEED AND AIR TEMPERATURE

MAY

INSUFFICIENT DATA

MAY SEA SURFACE TEMPERATURE

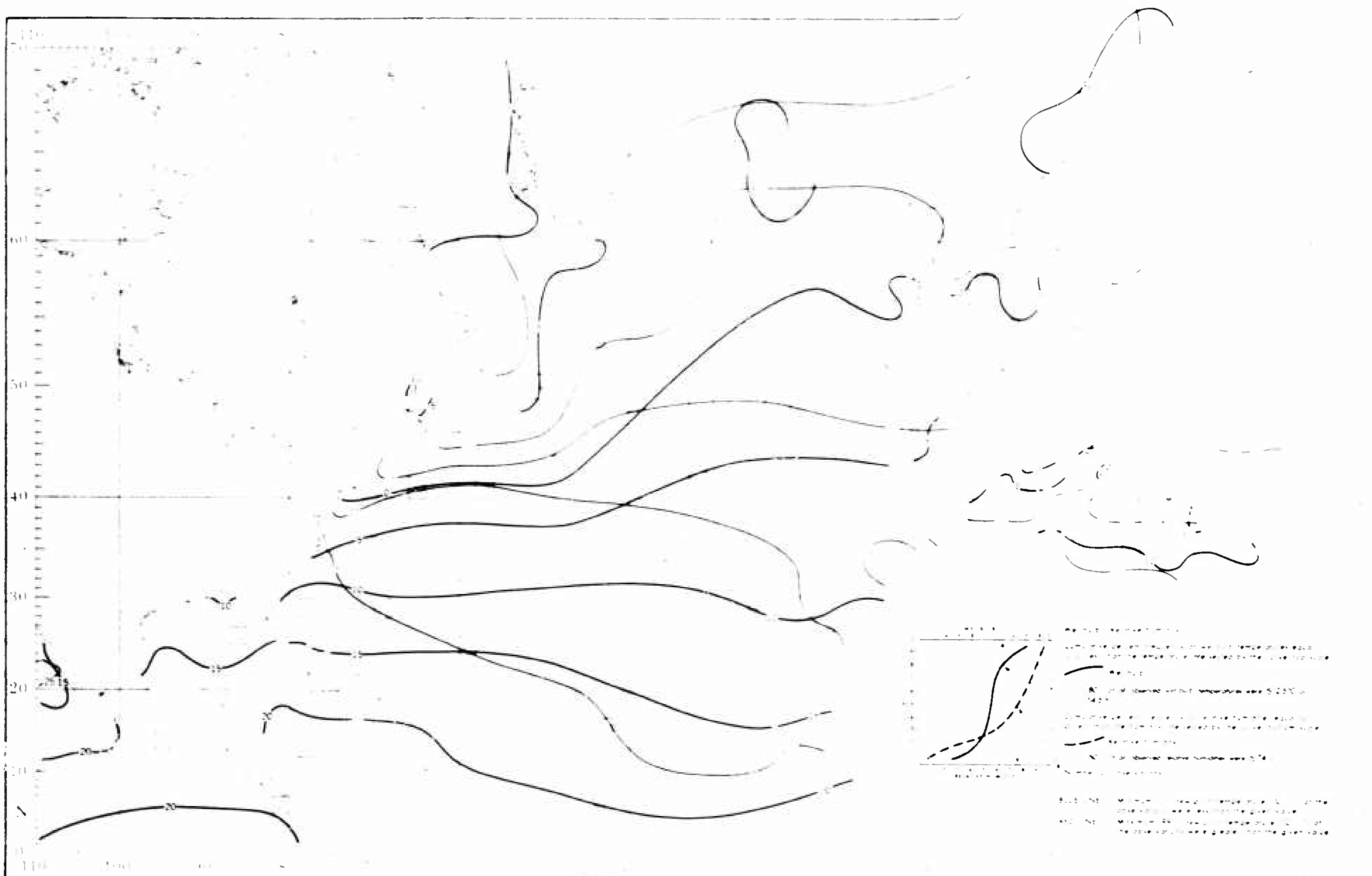


SEA SURFACE TEMPERATURE

MAY

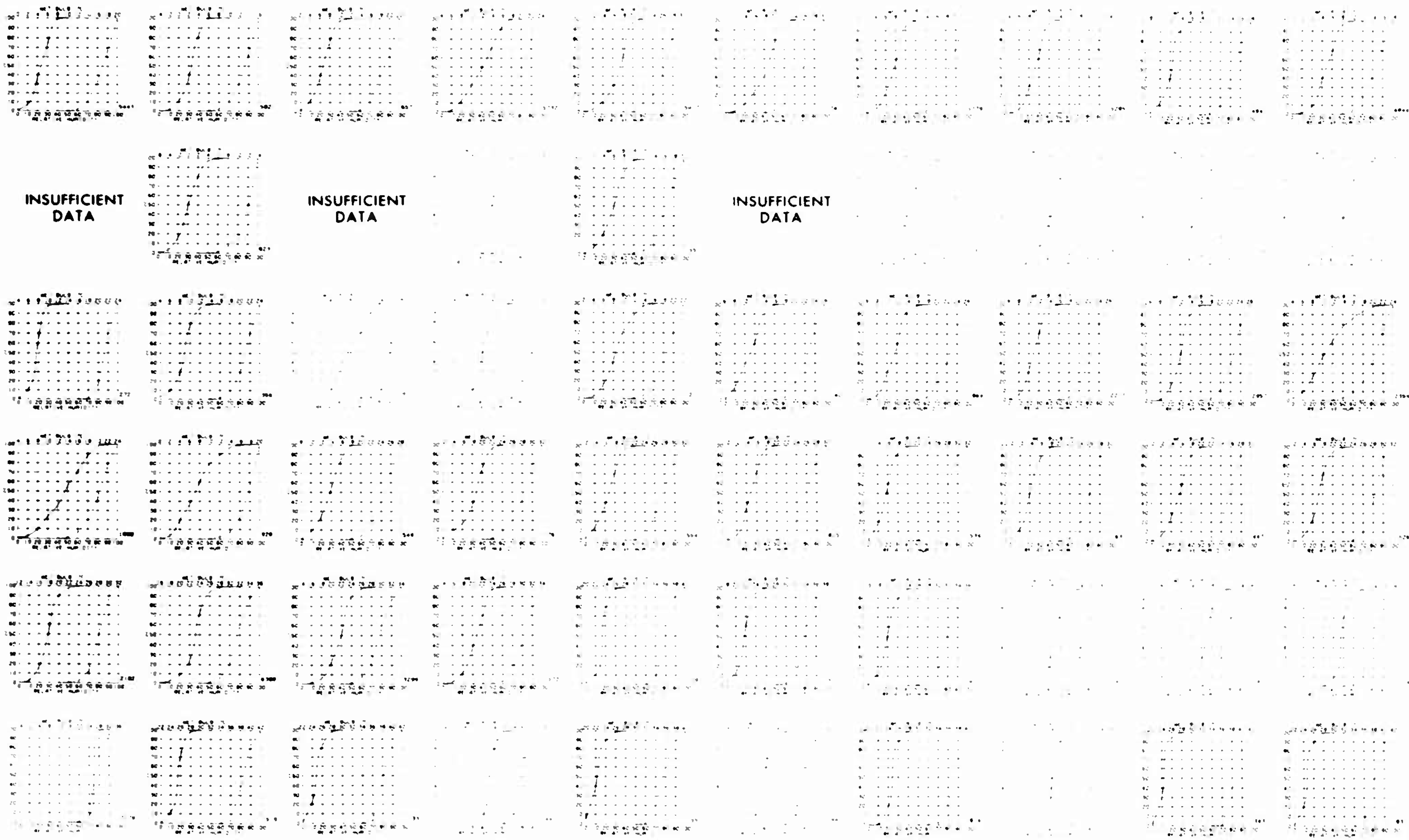
INSUFFICIENT
DATA

MAY HUMIDITY



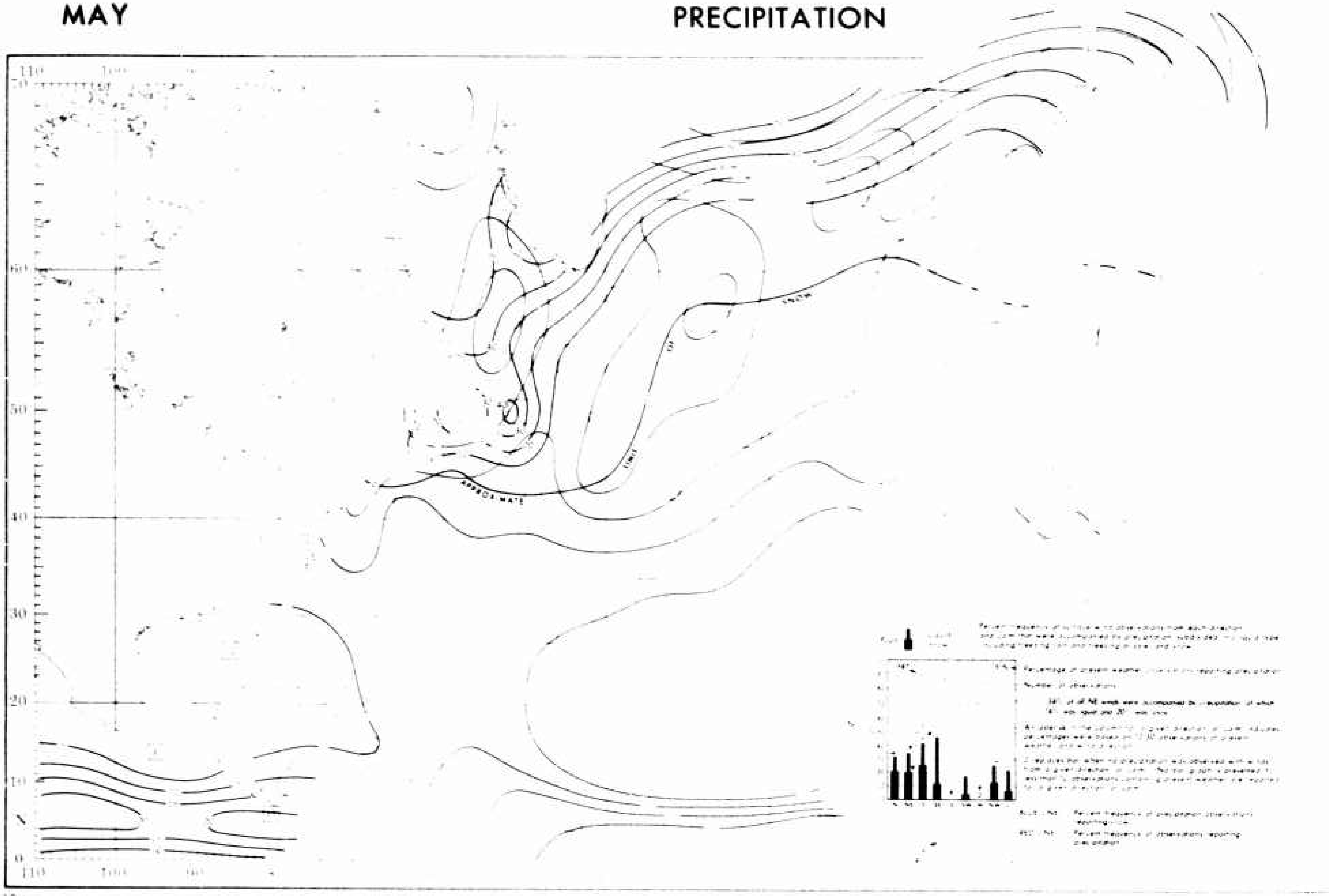
WET BULB AND RELATIVE HUMIDITY

MAY

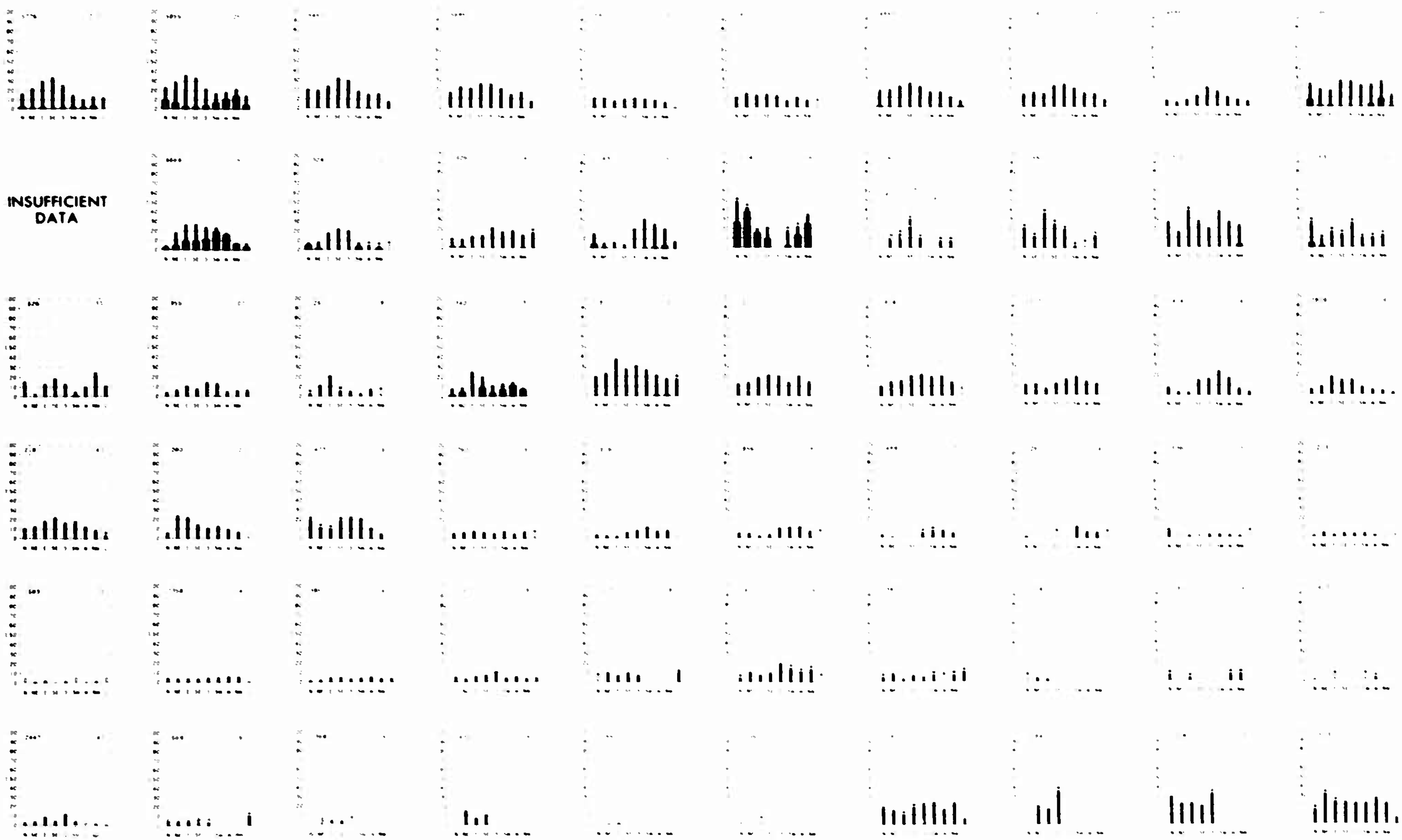


MAY

PRECIPITATION

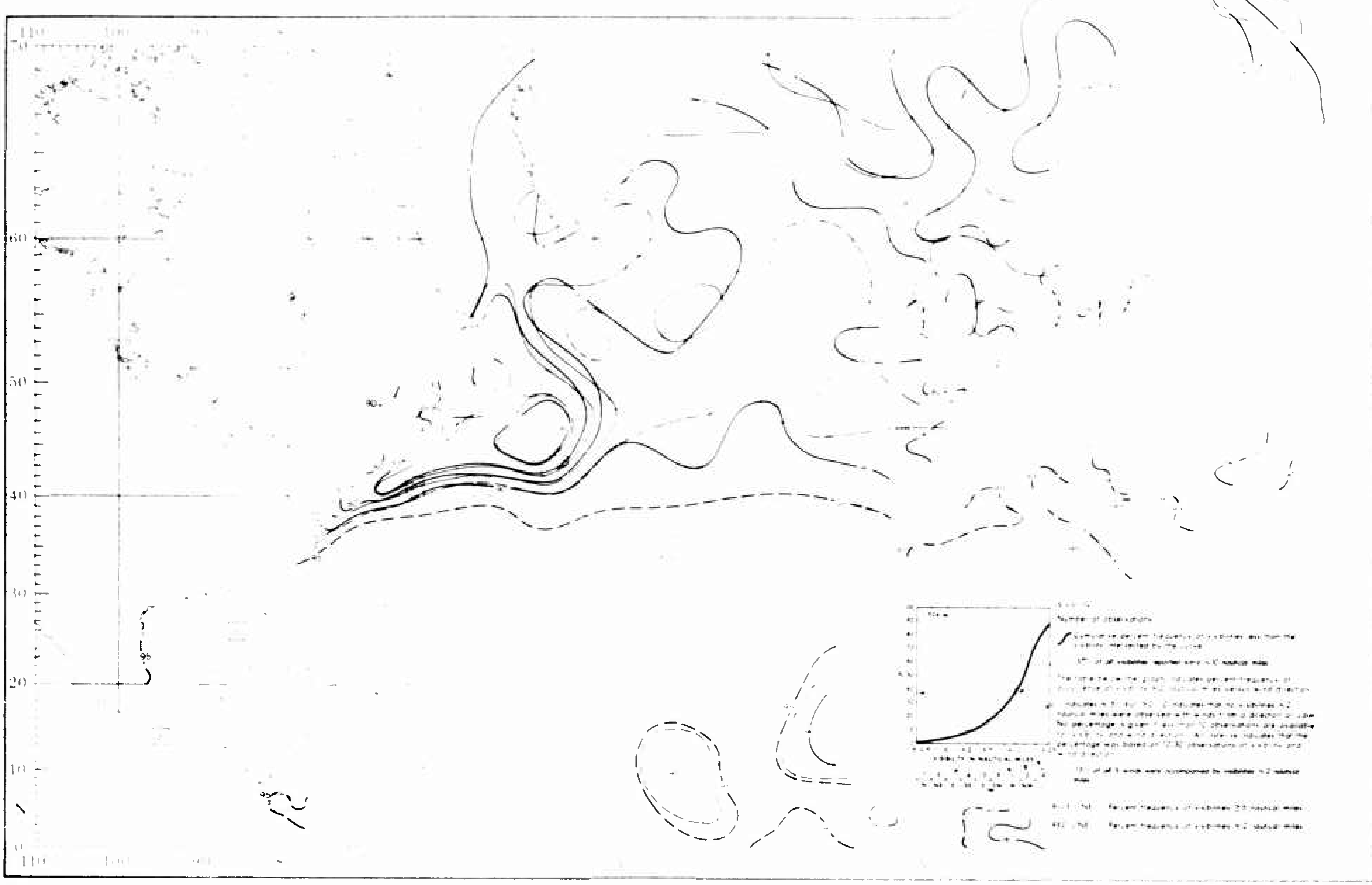


PRECIPITATION MAY



MAY

VISIBILITY



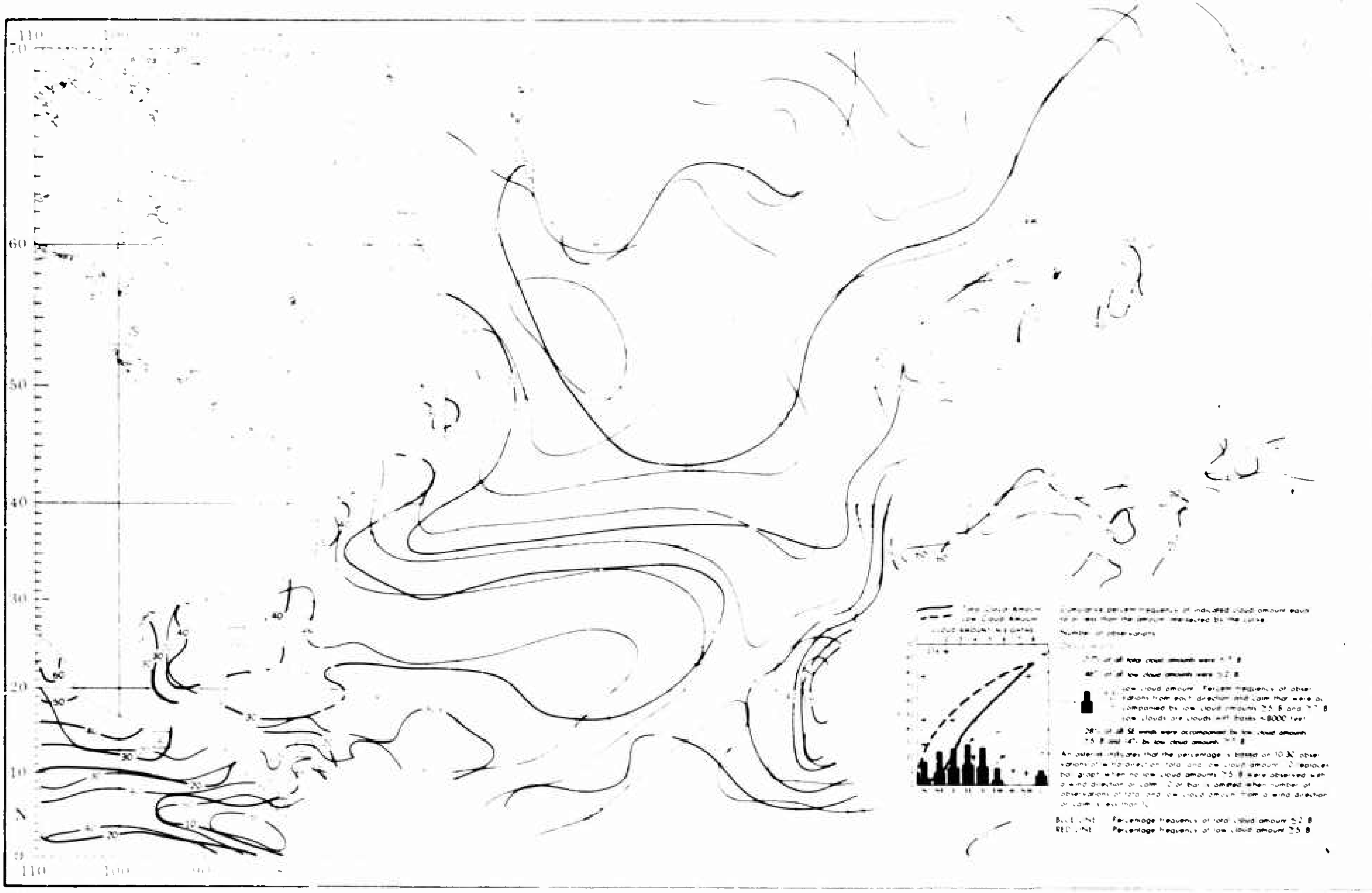
VISIBILITY

MAY

INSUFFICIENT DATA

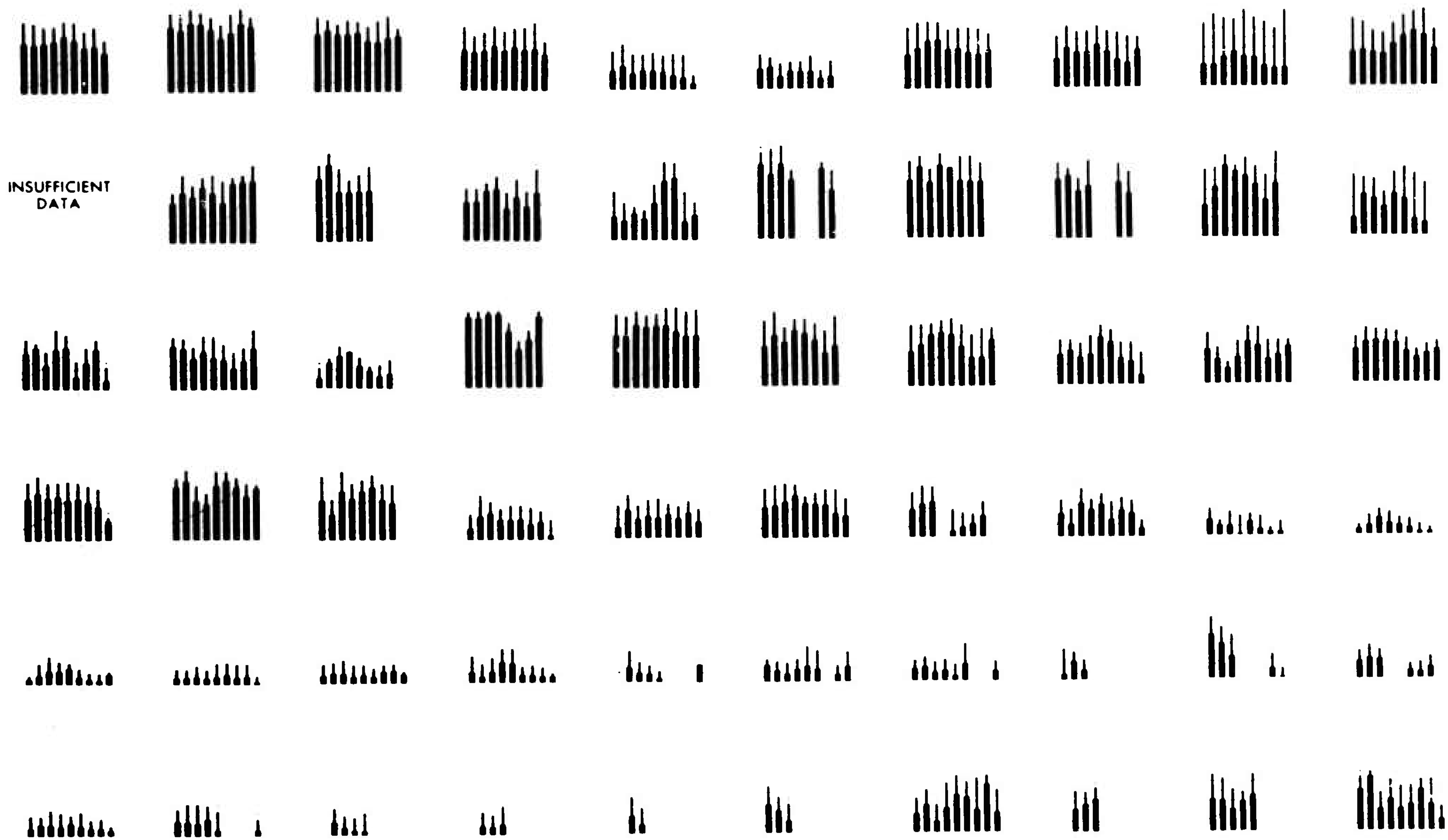
MAY

CLOUD COVER

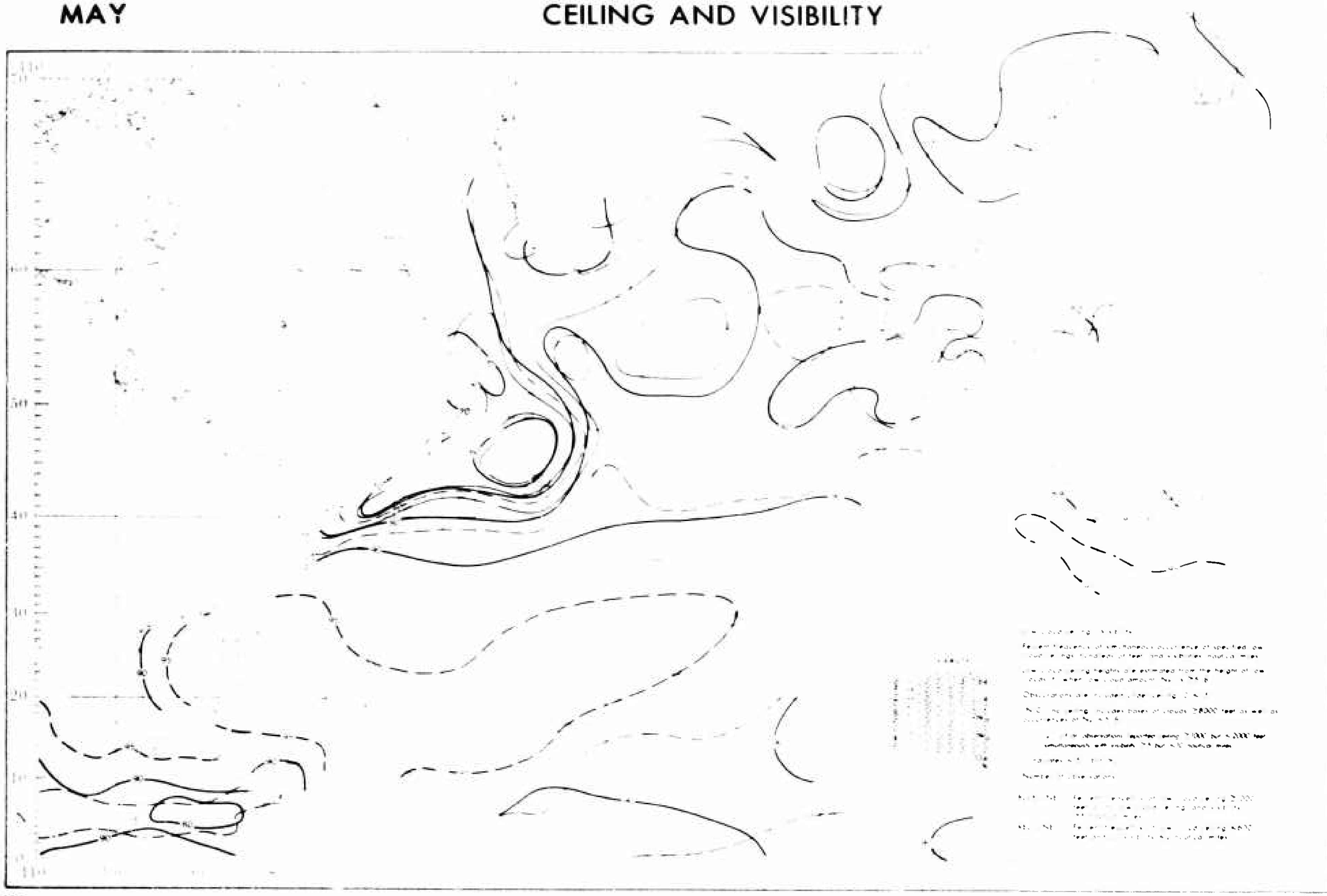


CLOUD COVER

MAY



CEILING AND VISIBILITY



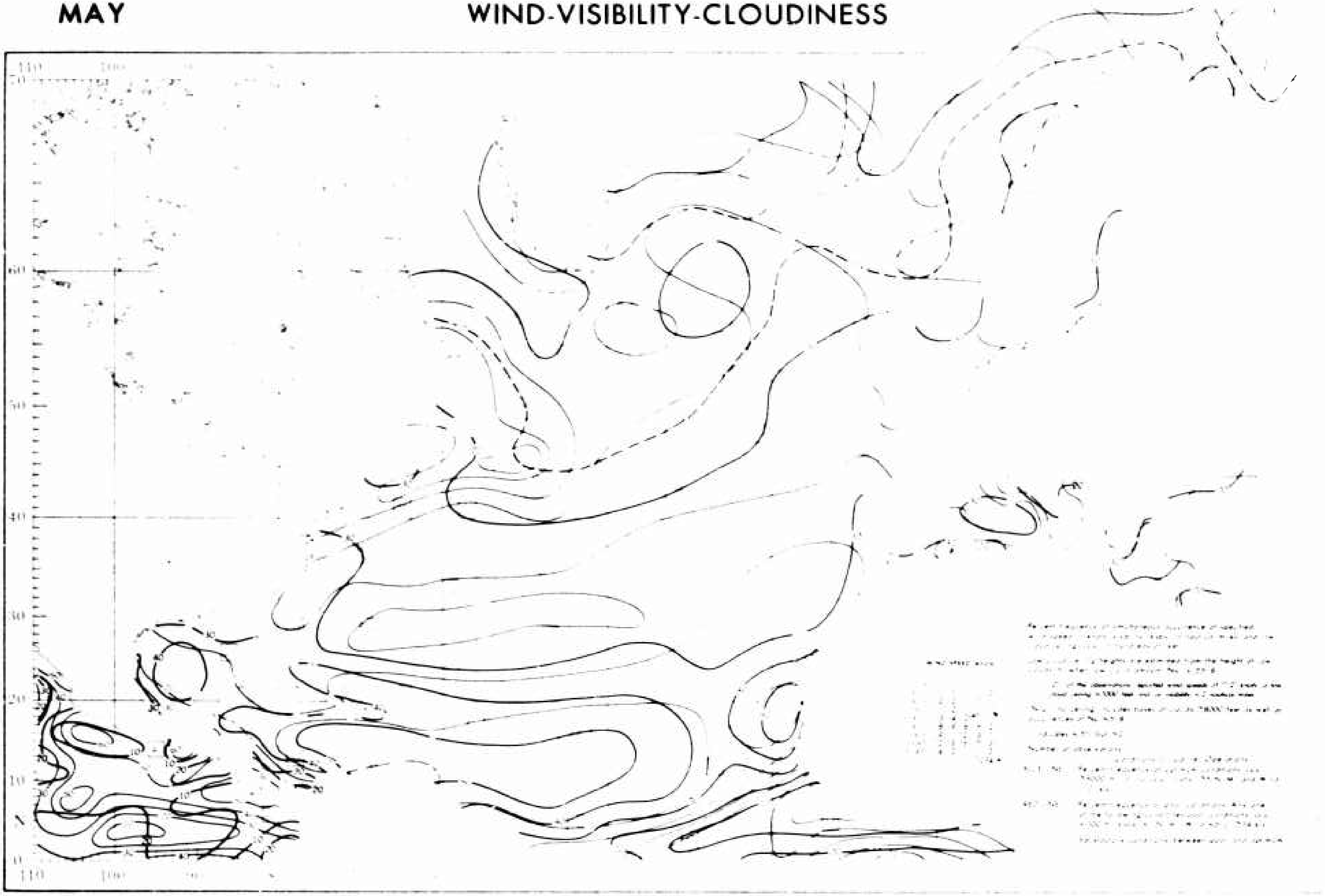
CEILING AND VISIBILITY

MAY

INSUFFICIENT DATA

MAY

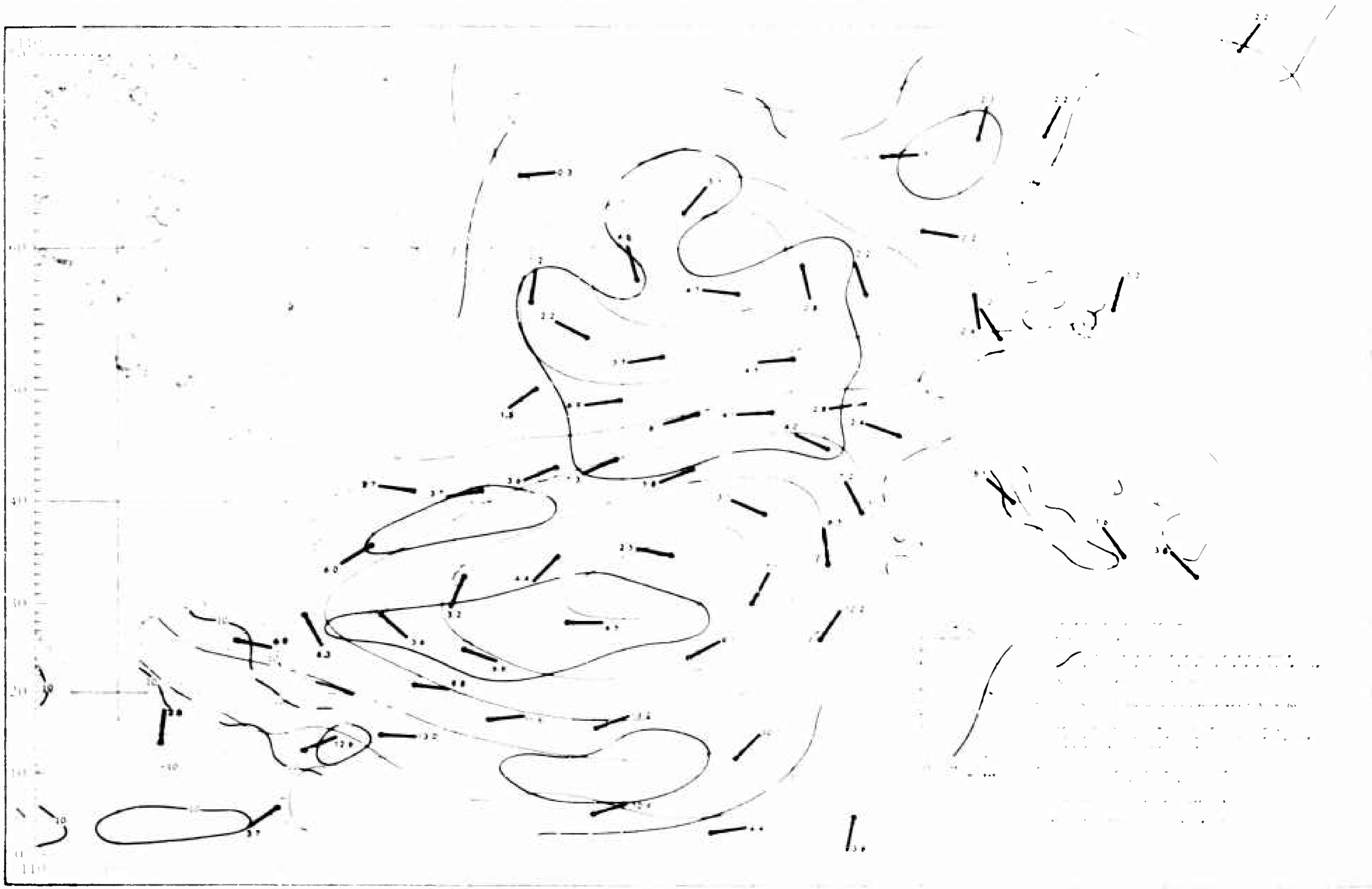
WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

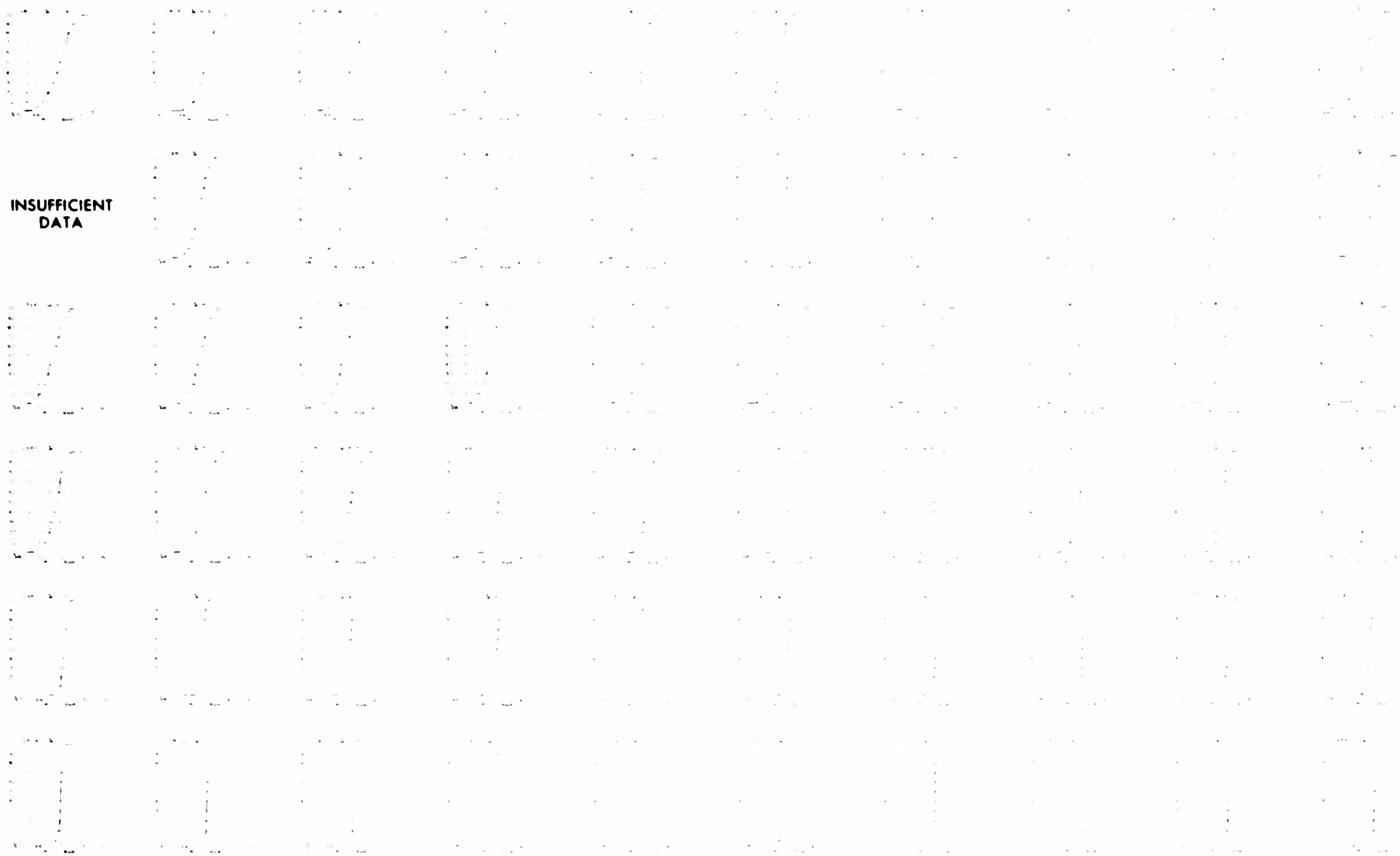
MAY

MAY SEA-LEVEL PRESSURE AND MEAN WIND



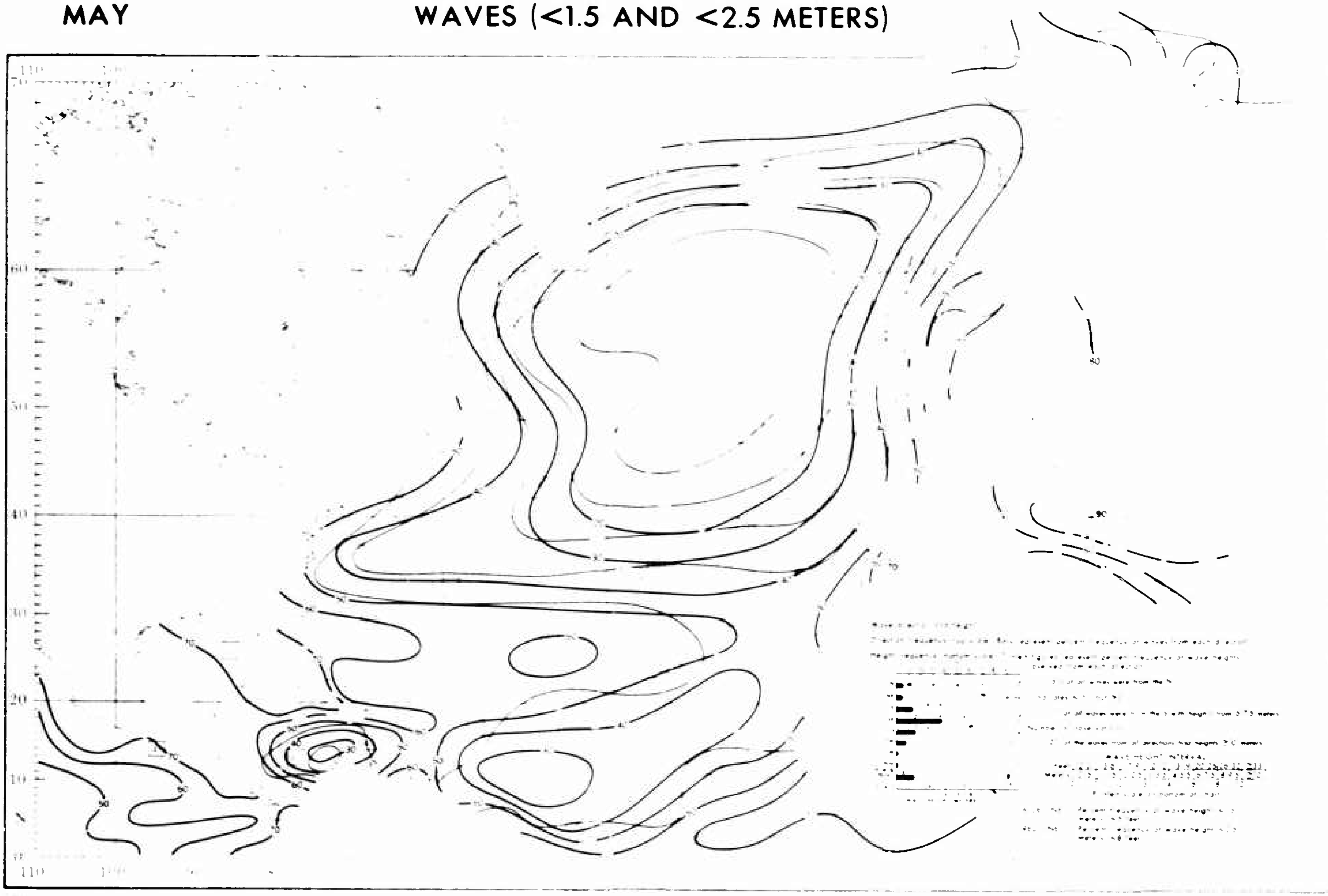
SEA LEVEL PRESSURE

MAY



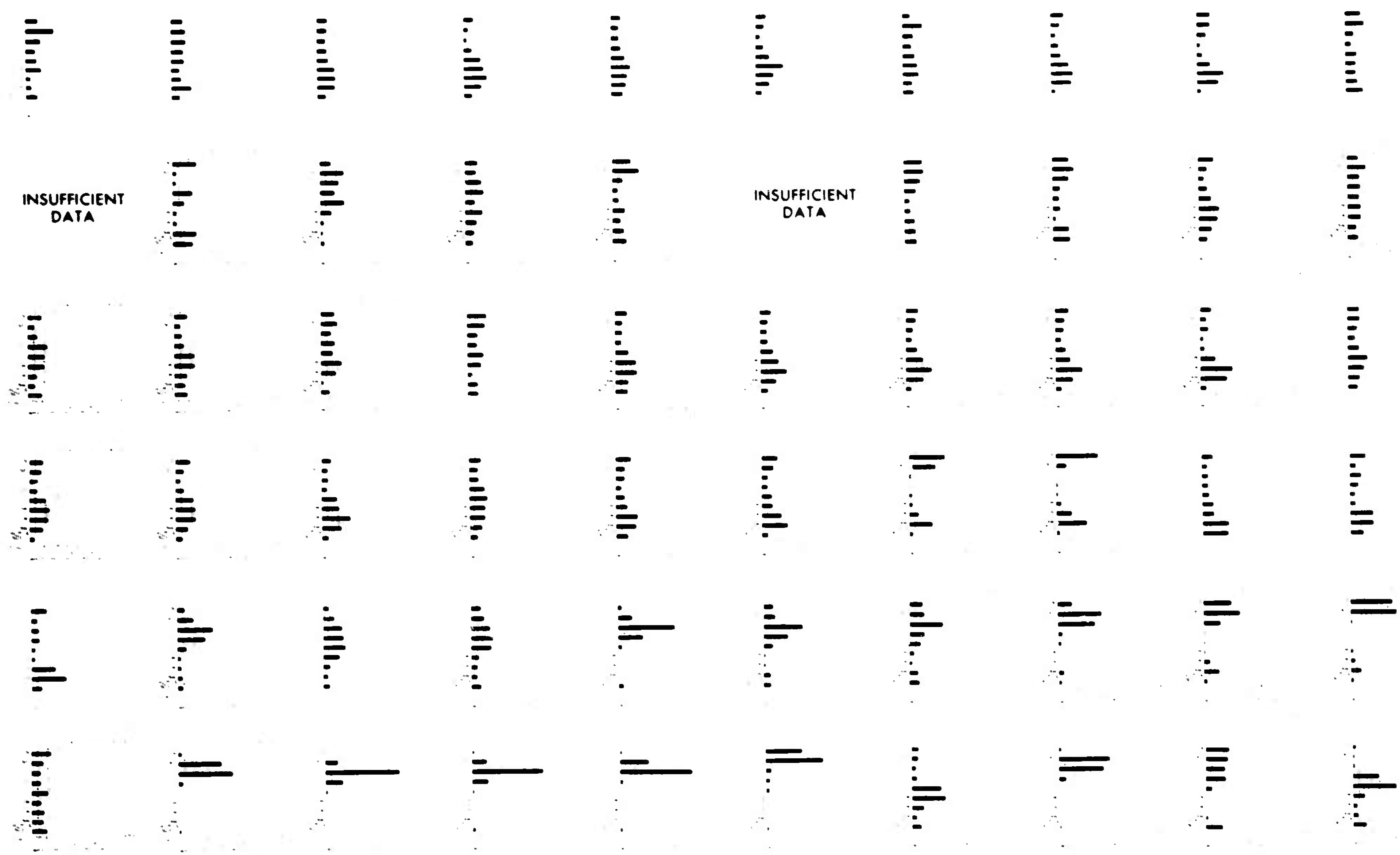
MAY

WAVES (<1.5 AND <2.5 METERS)



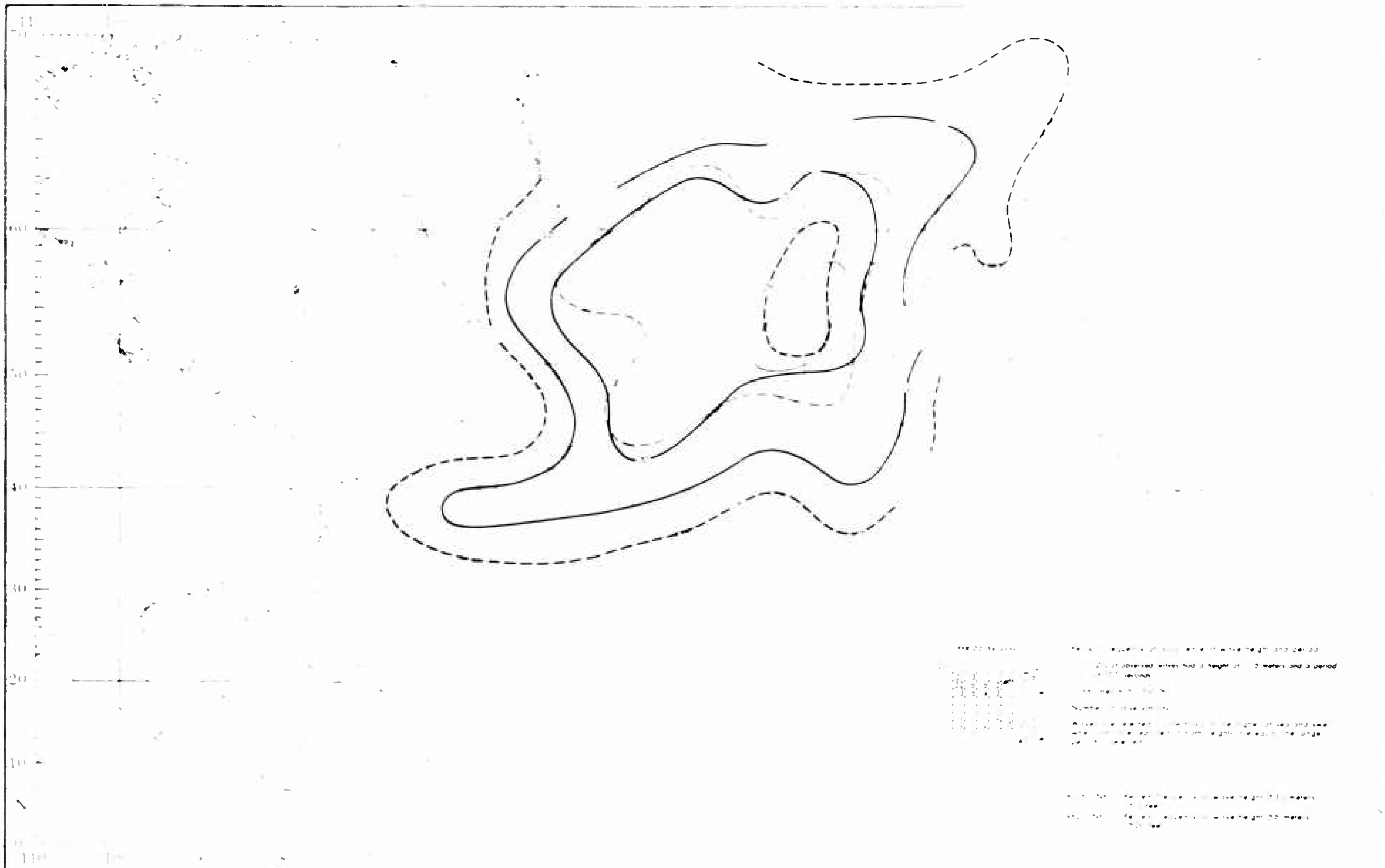
WAVE DIRECTION AND HEIGHT

MAY



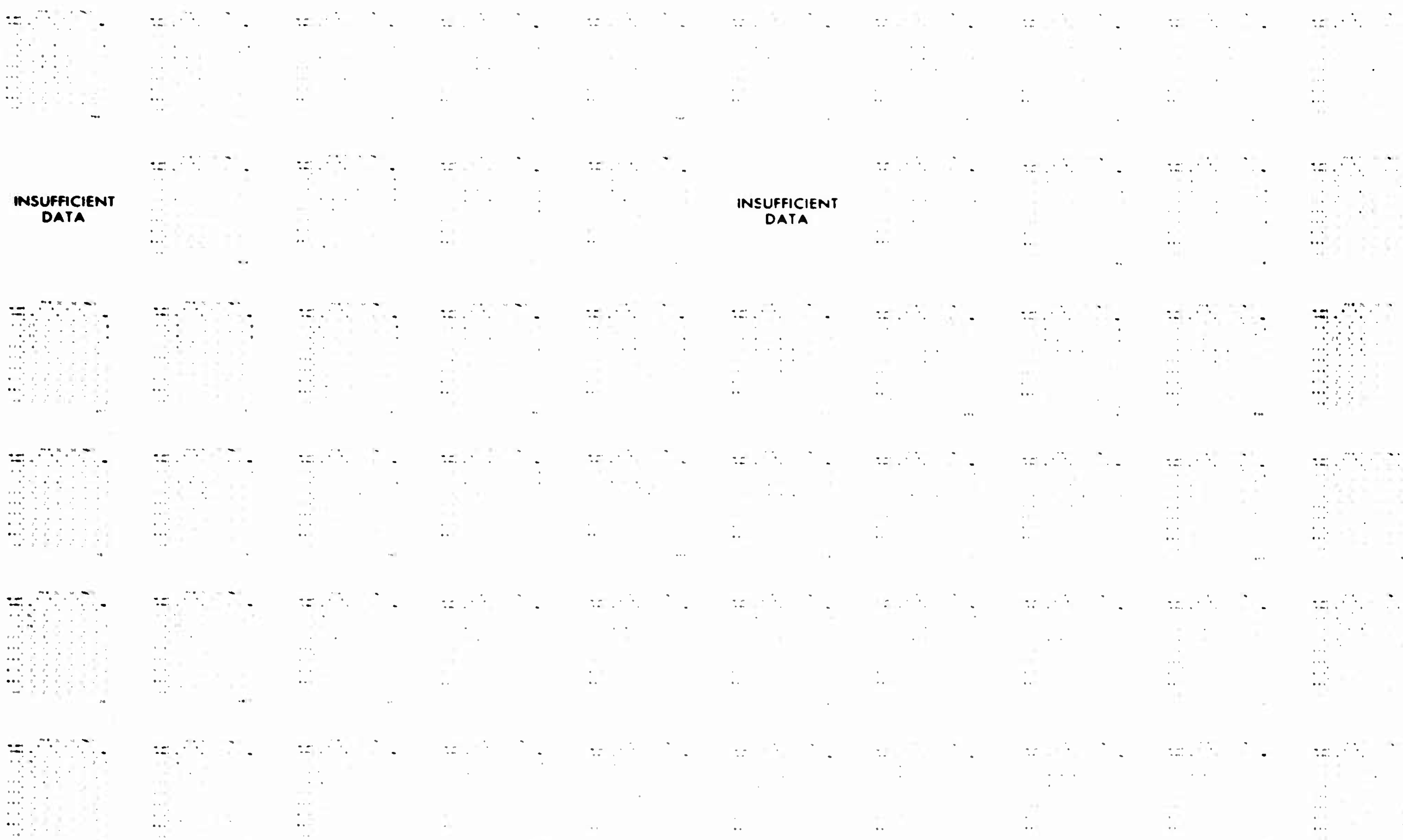
MAY

WAVES (≥3.5 AND ≥6 METERS)



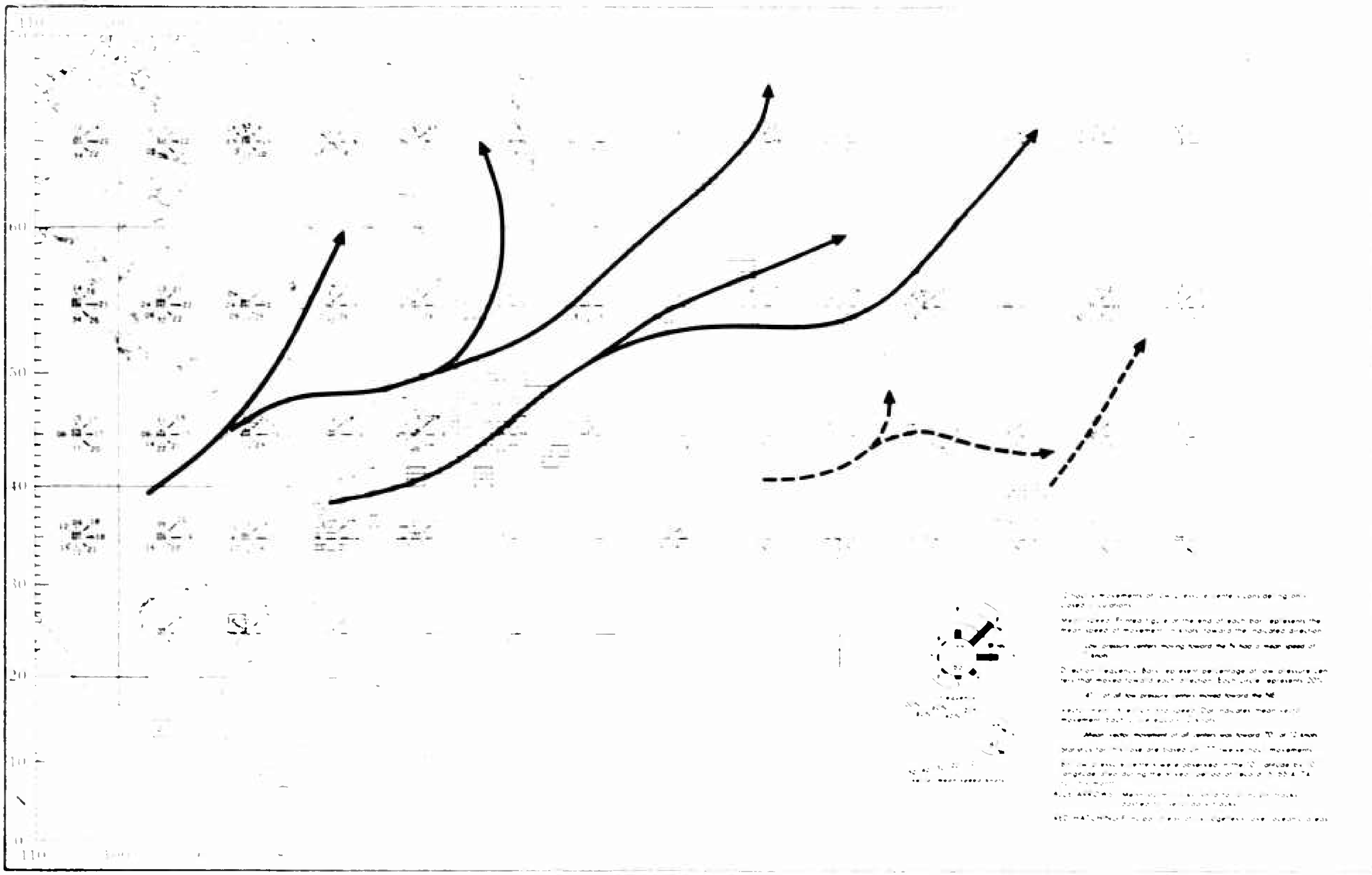
WAVE PERIOD AND HEIGHT

MAY



MAY

LOW PRESSURE CENTERS



TROPICAL CYCLONE

MAY

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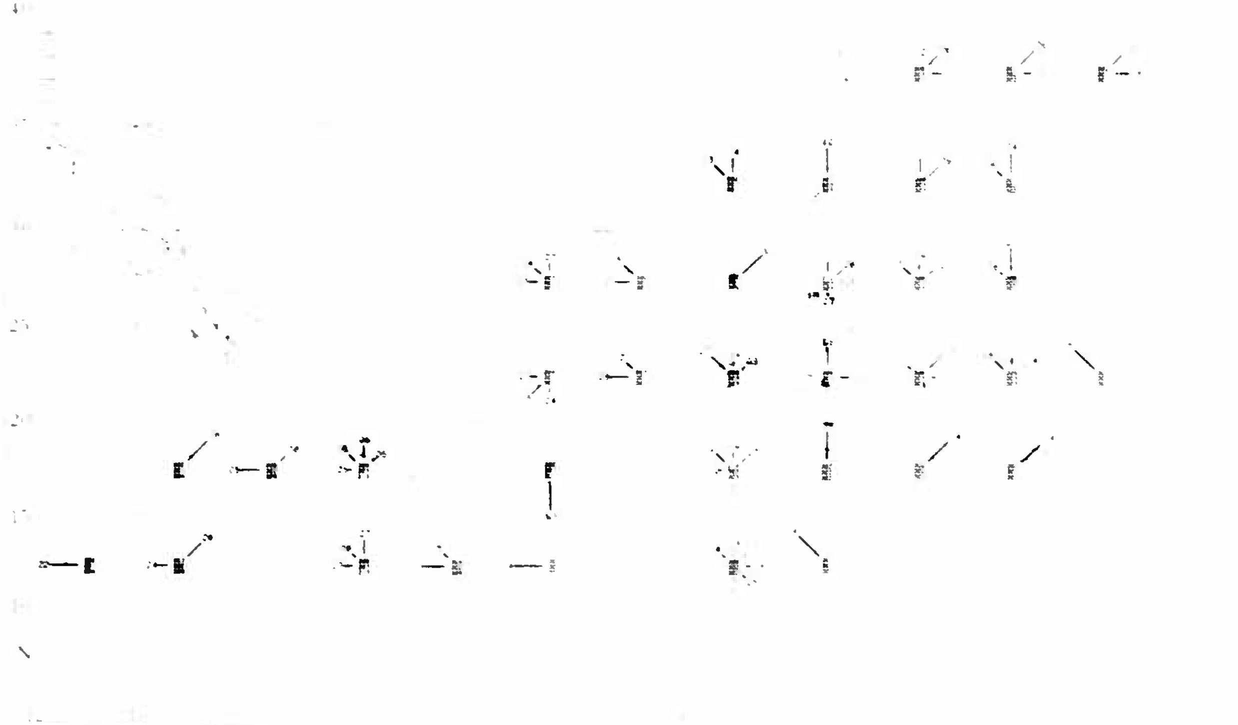
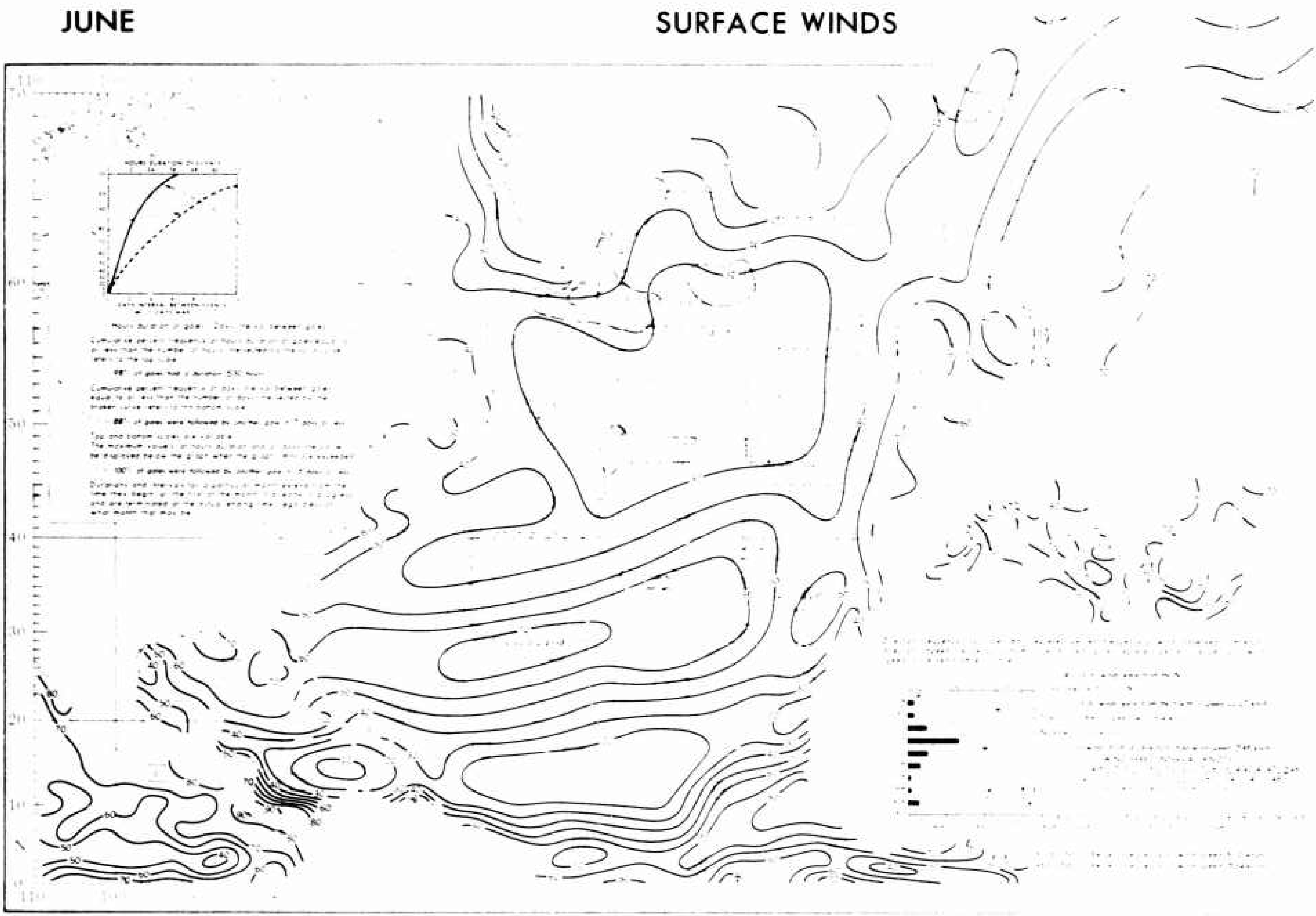


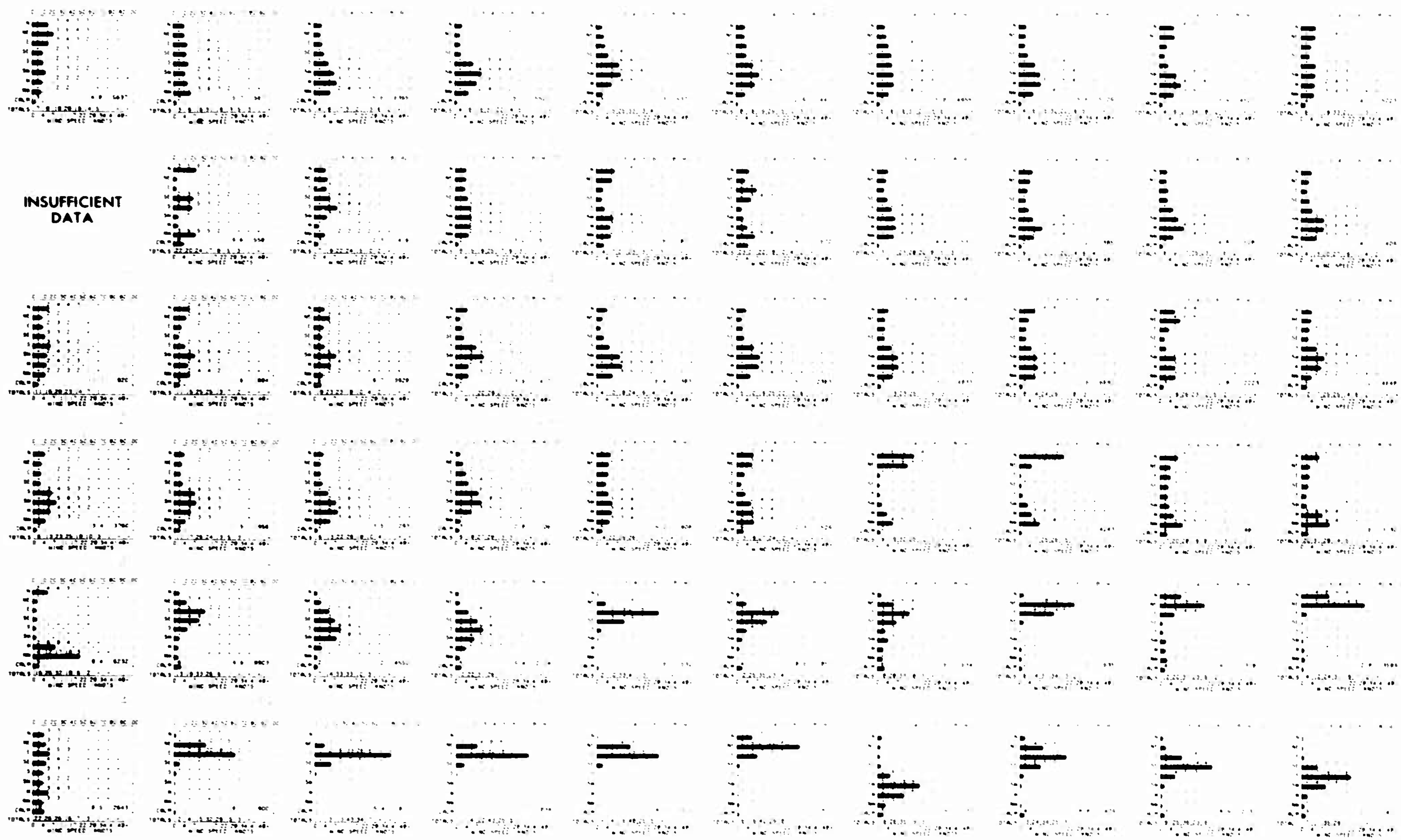
JUNE

SURFACE WINDS



WIND DIRECTION AND SPEED

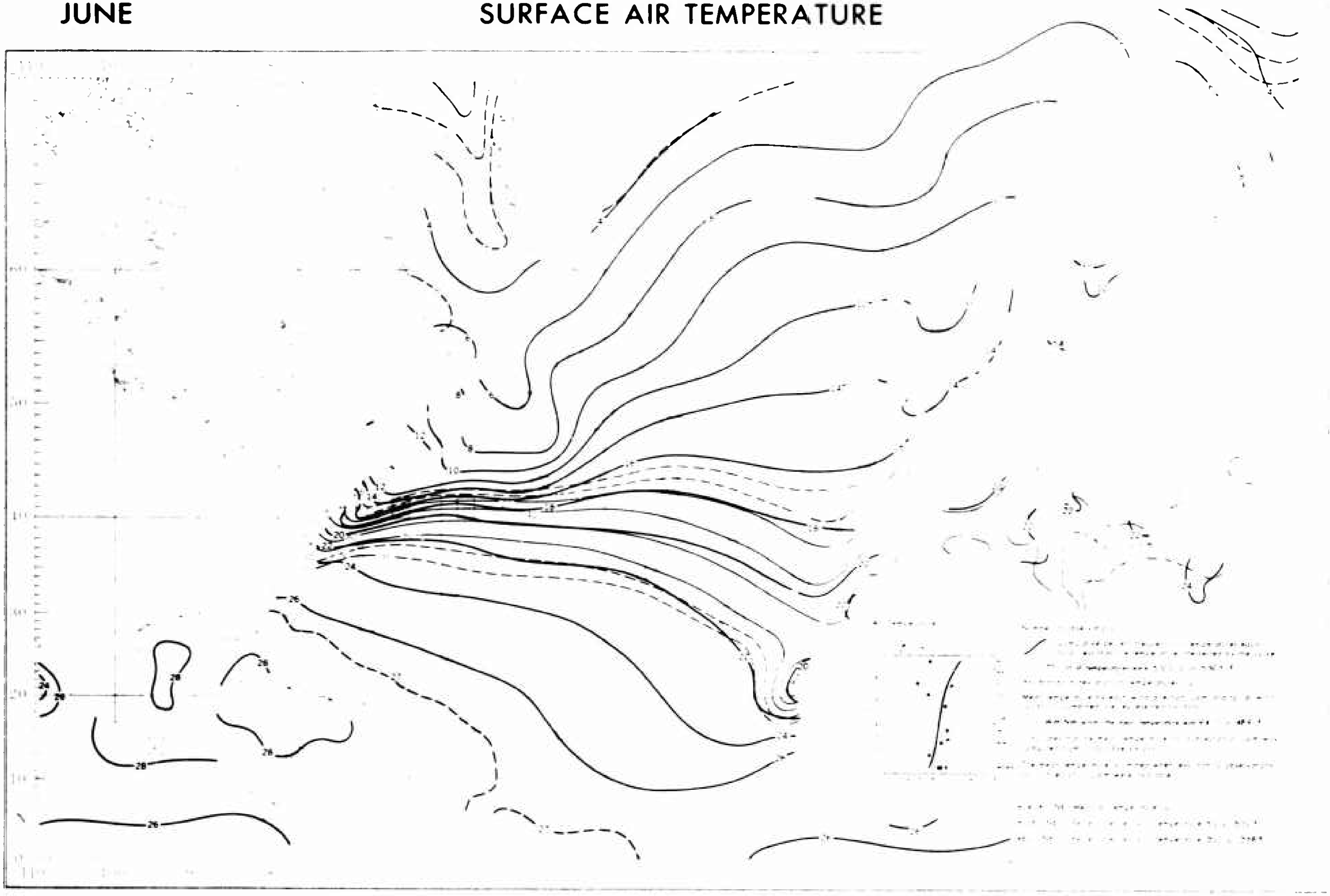
JUNE



INSUFFICIENT DATA

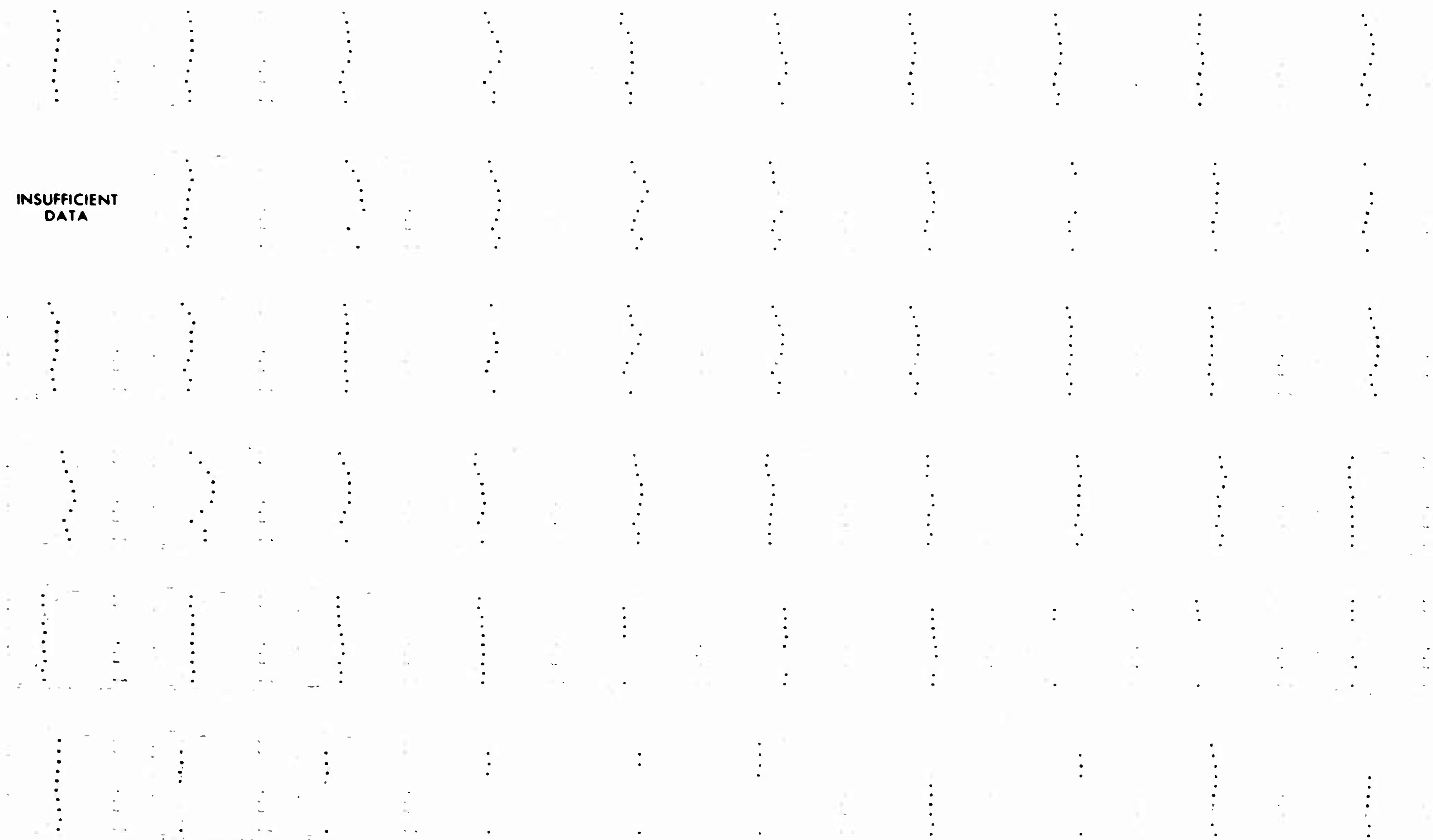
JUNE

SURFACE AIR TEMPERATURE

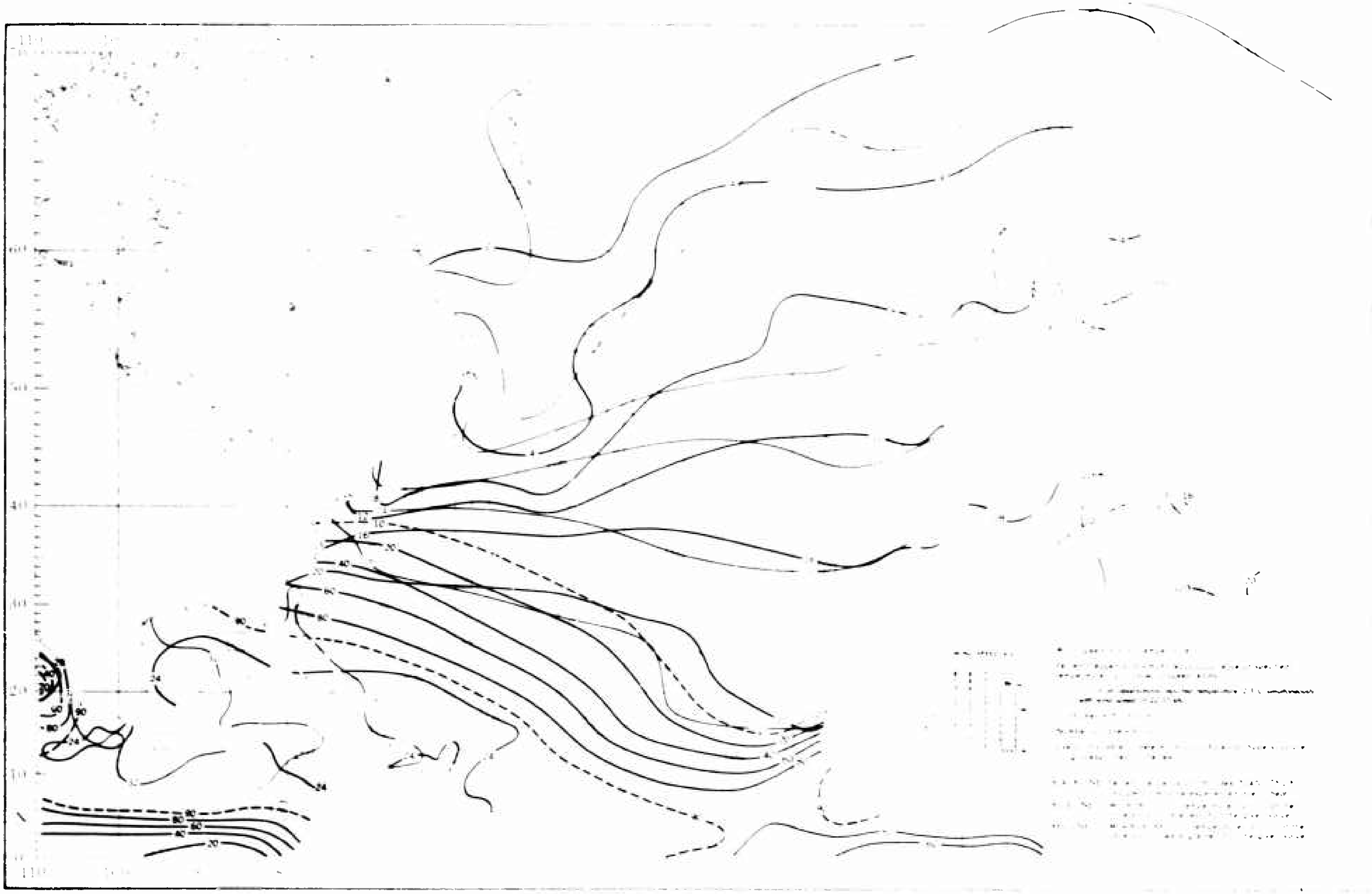


SURFACE AIR TEMPERATURE

JUNE



JUNE TEMPERATURE EXTREMES AND T-H INDEX



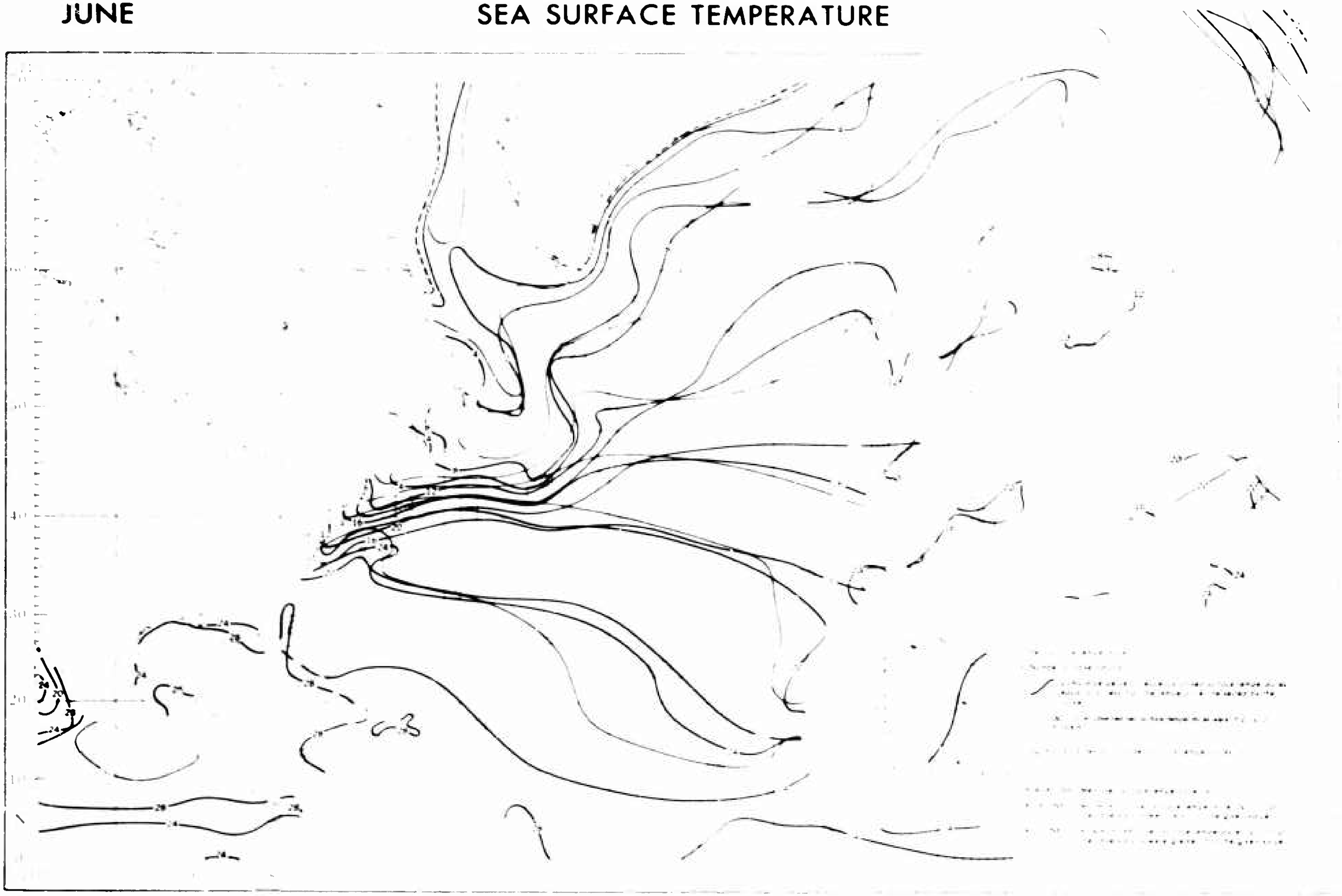
WIND SPEED AND AIR TEMPERATURE

JUNE

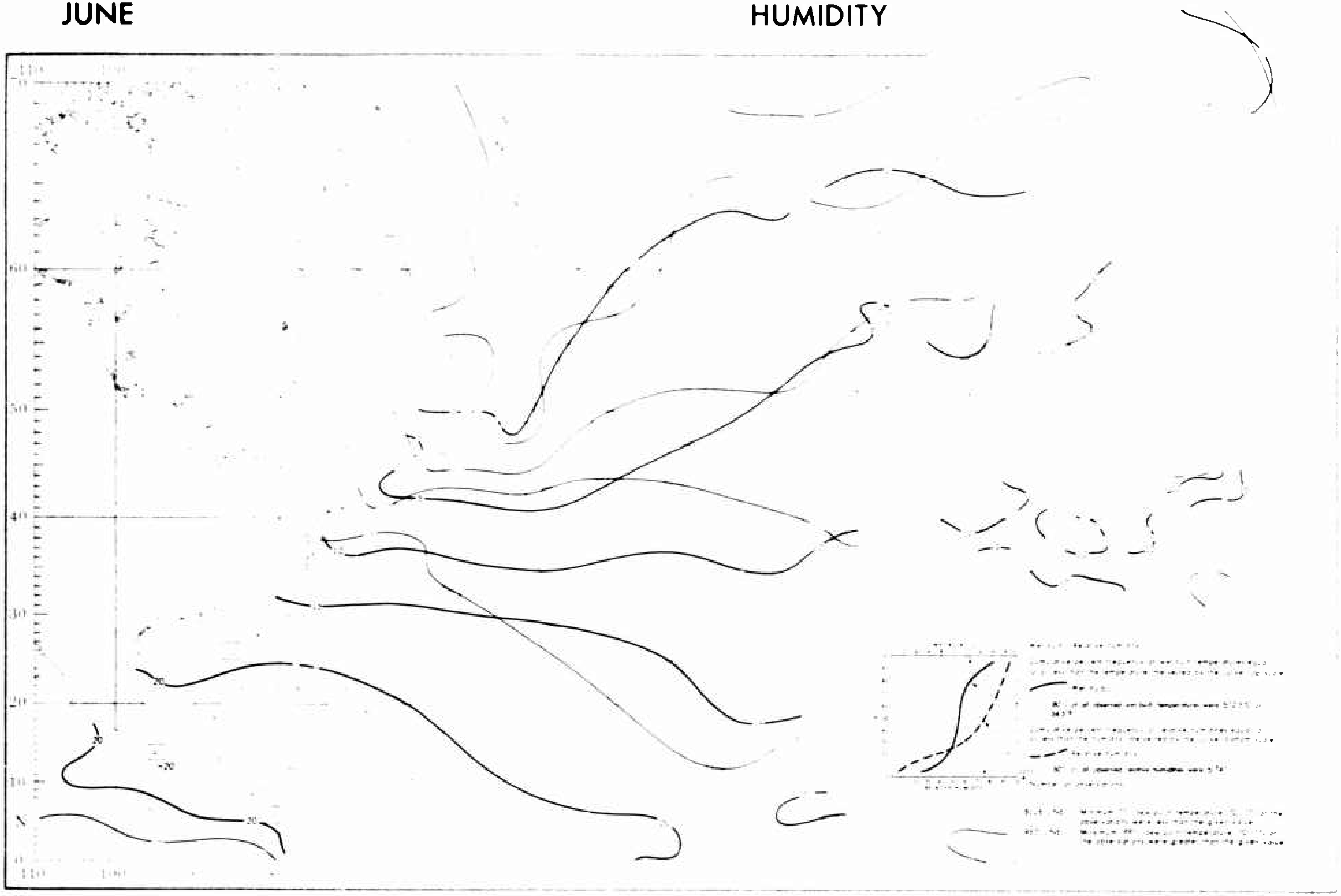
INSUFFICIENT DATA

JUNE

SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE JUNE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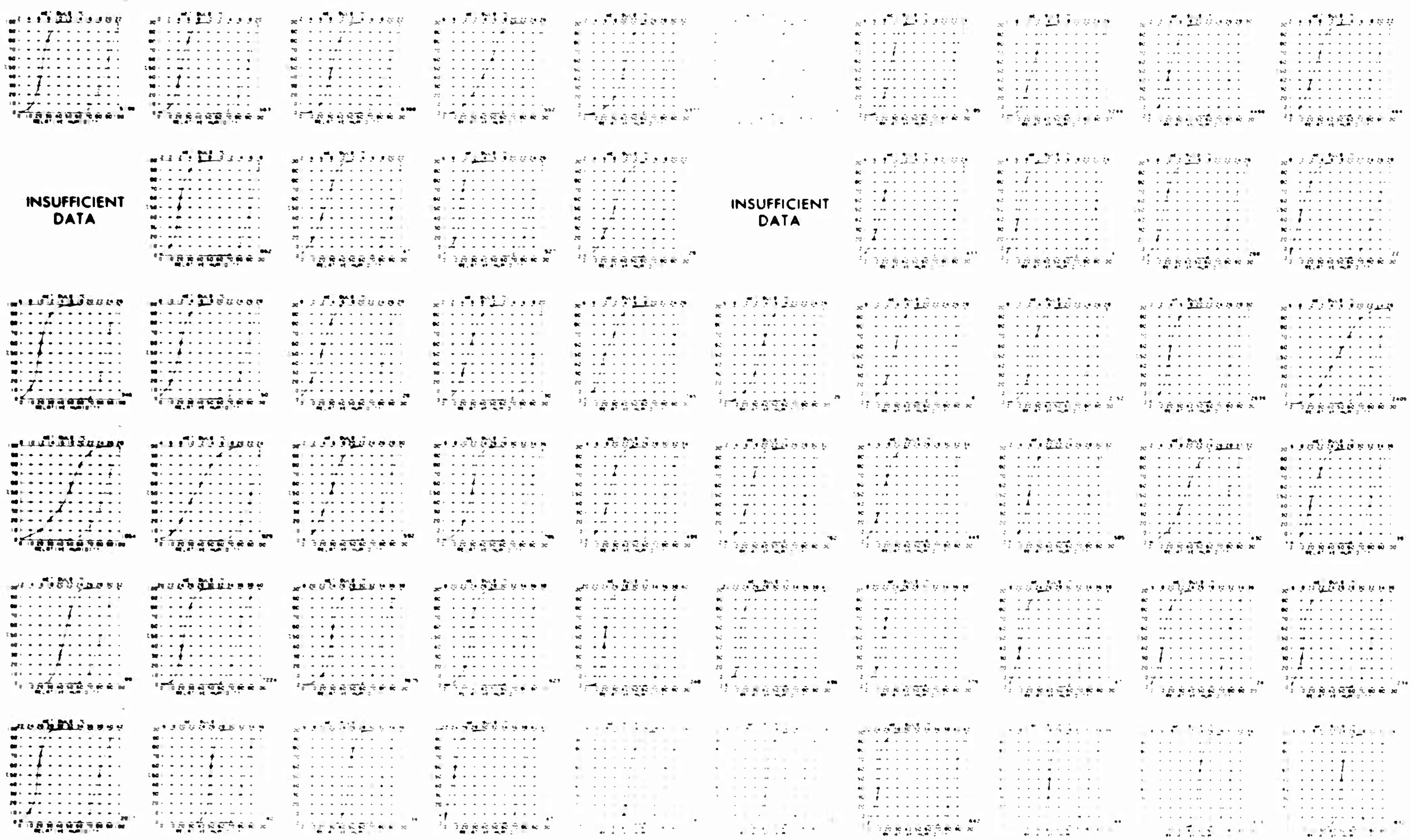
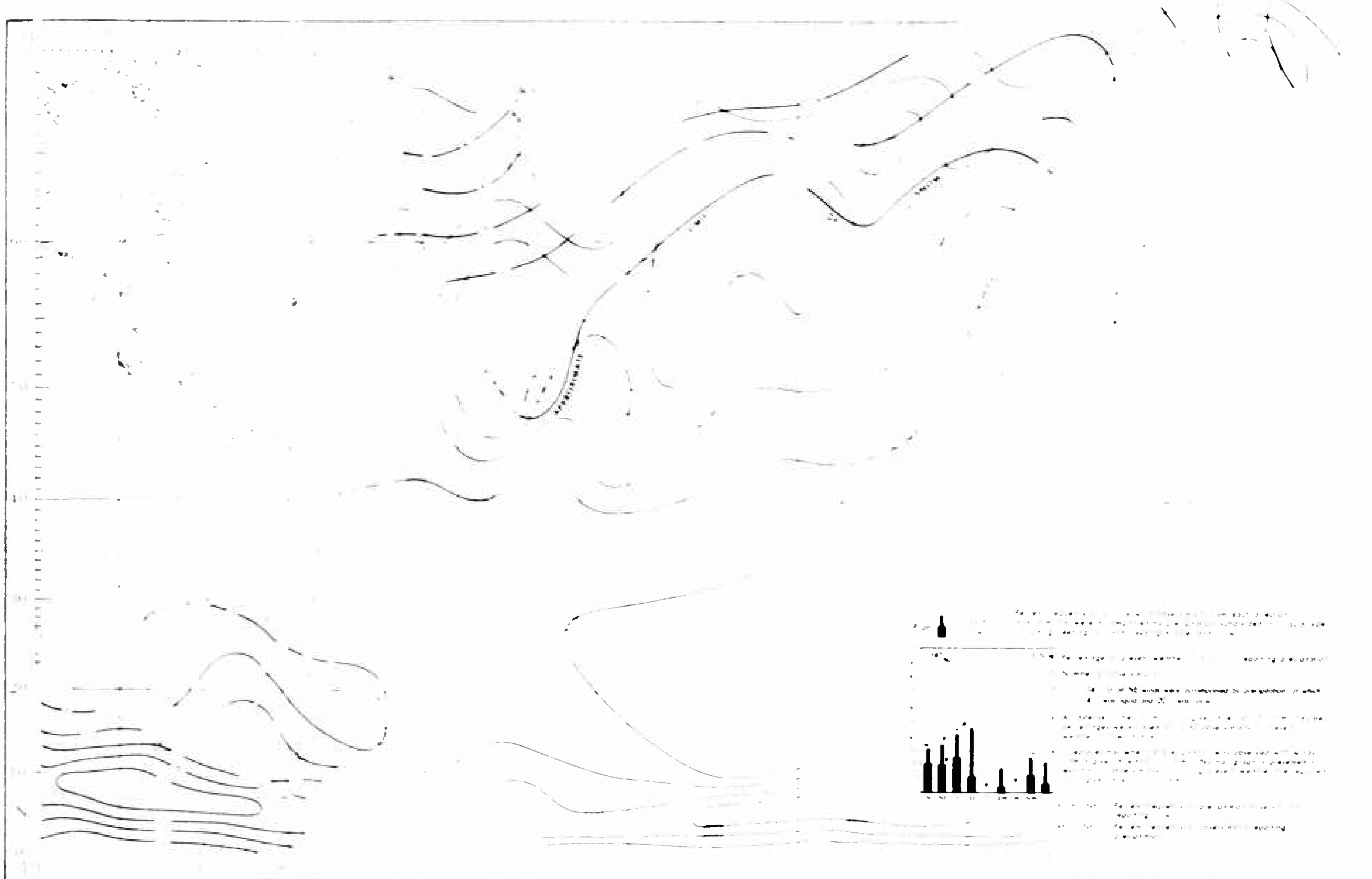
WET BULB AND RELATIVE HUMIDITY

JUNE

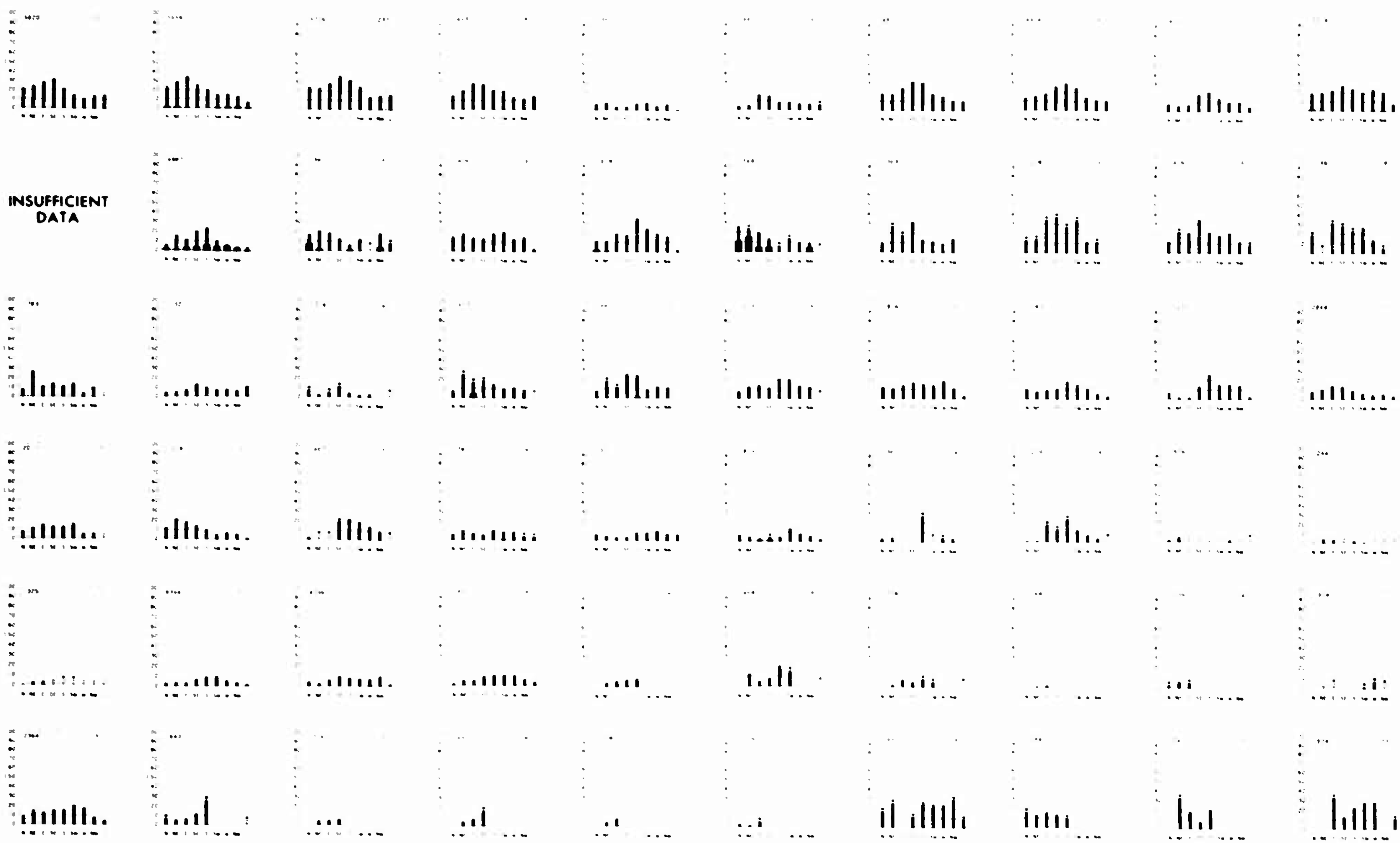


PRECIPITATION



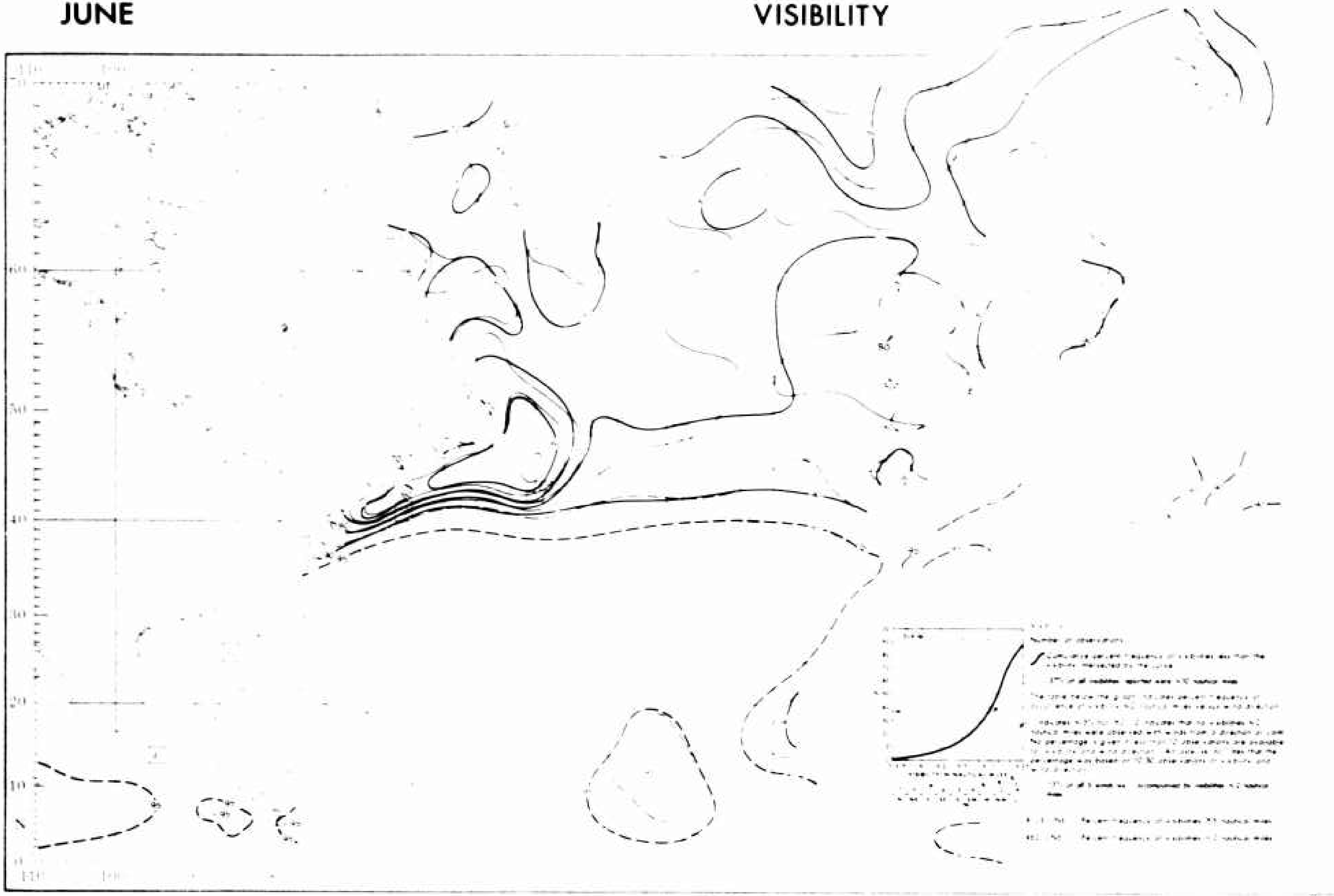
PRECIPITATION

JUNE



JUNE

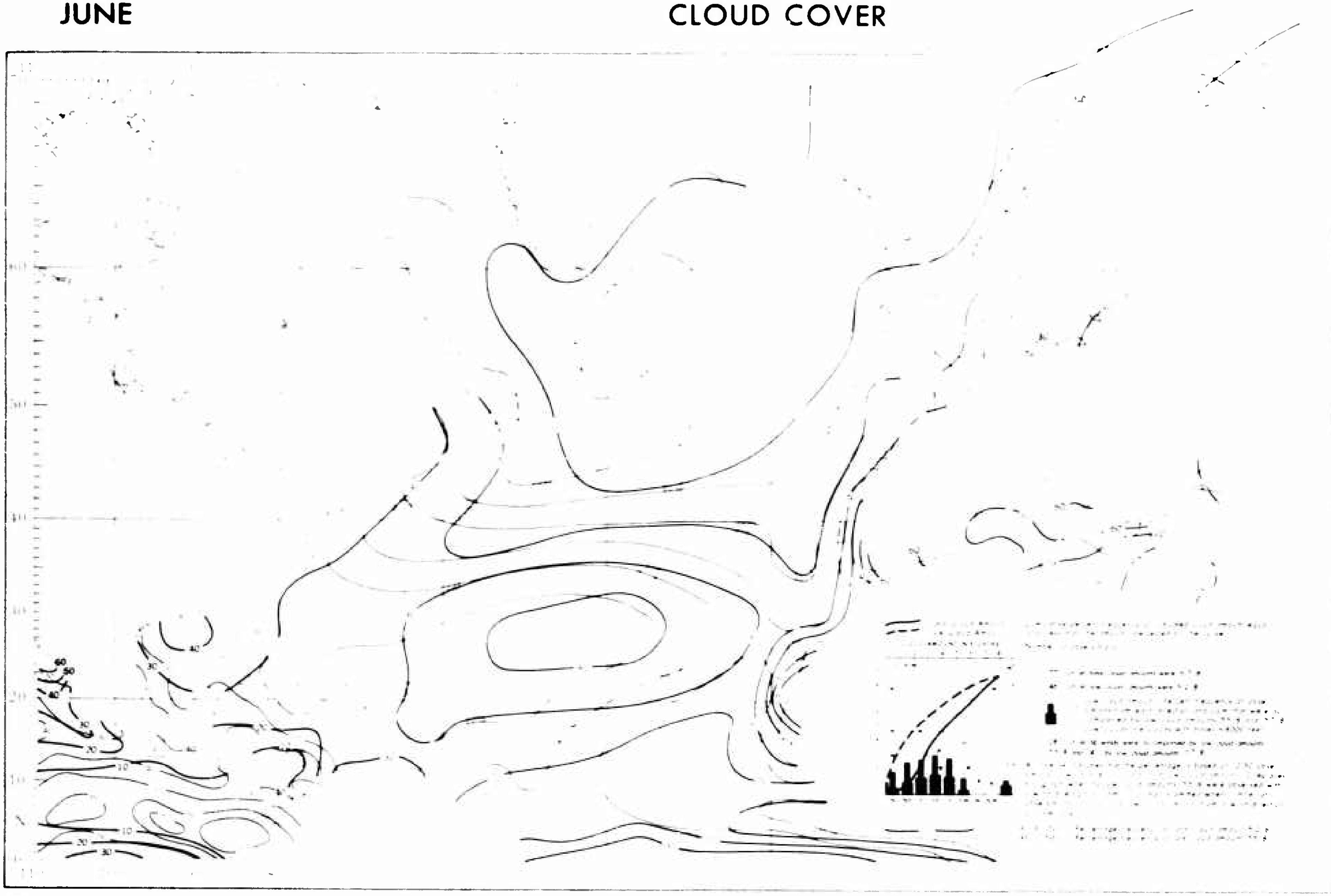
VISIBILITY



INSUFFICIENT DATA

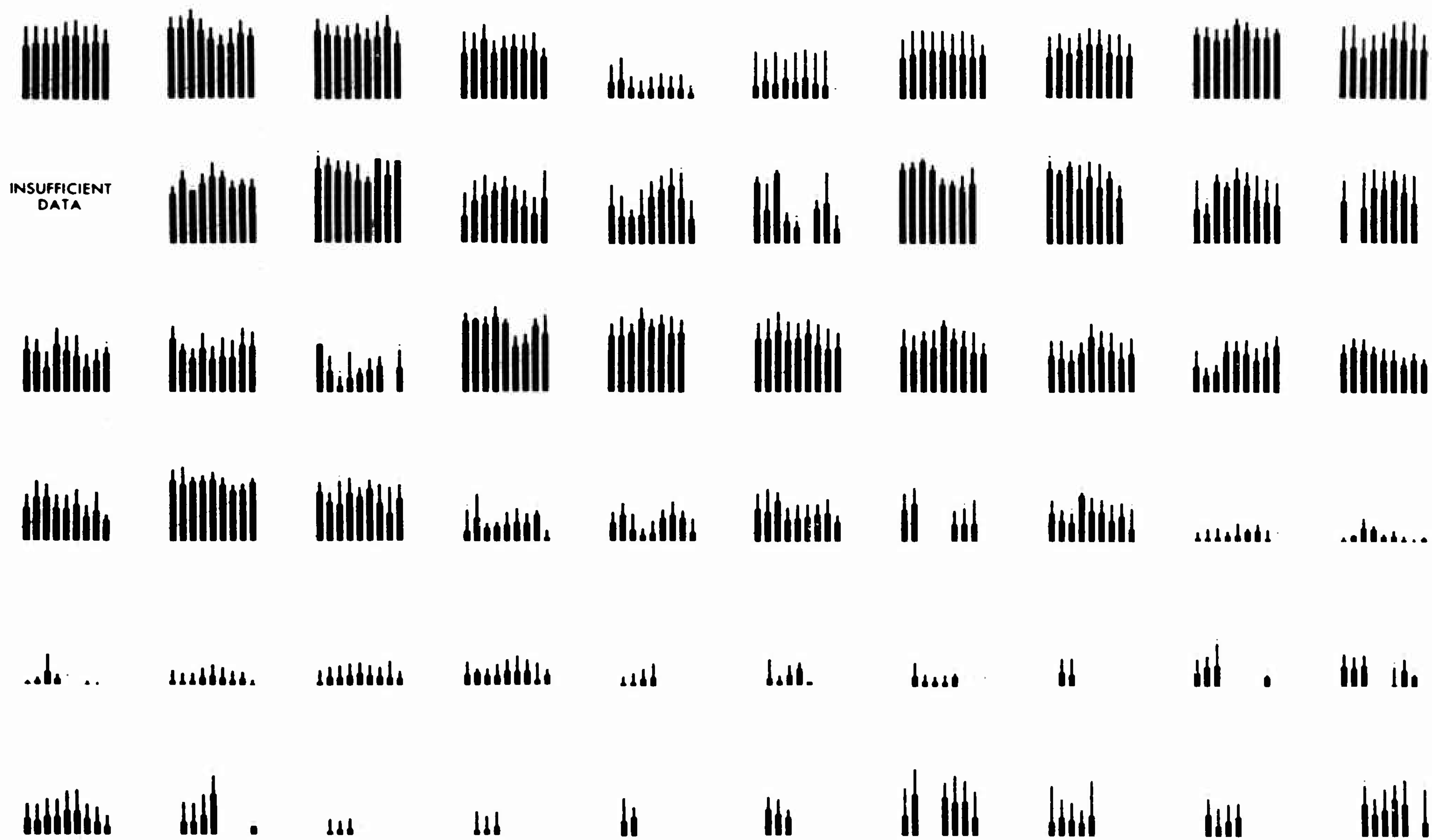
JUNE

CLOUD COVER



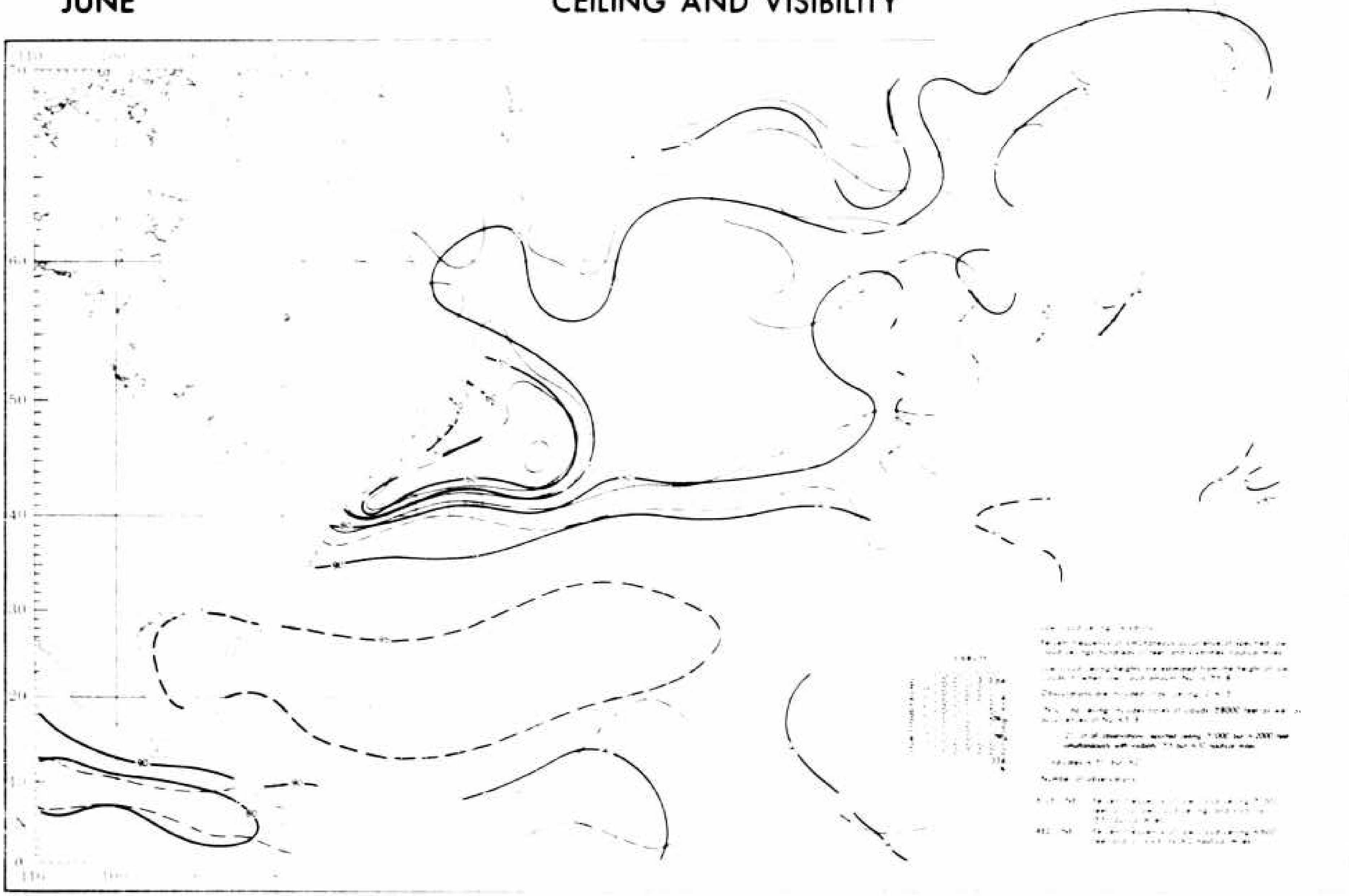
CLOUD COVER

JUNE



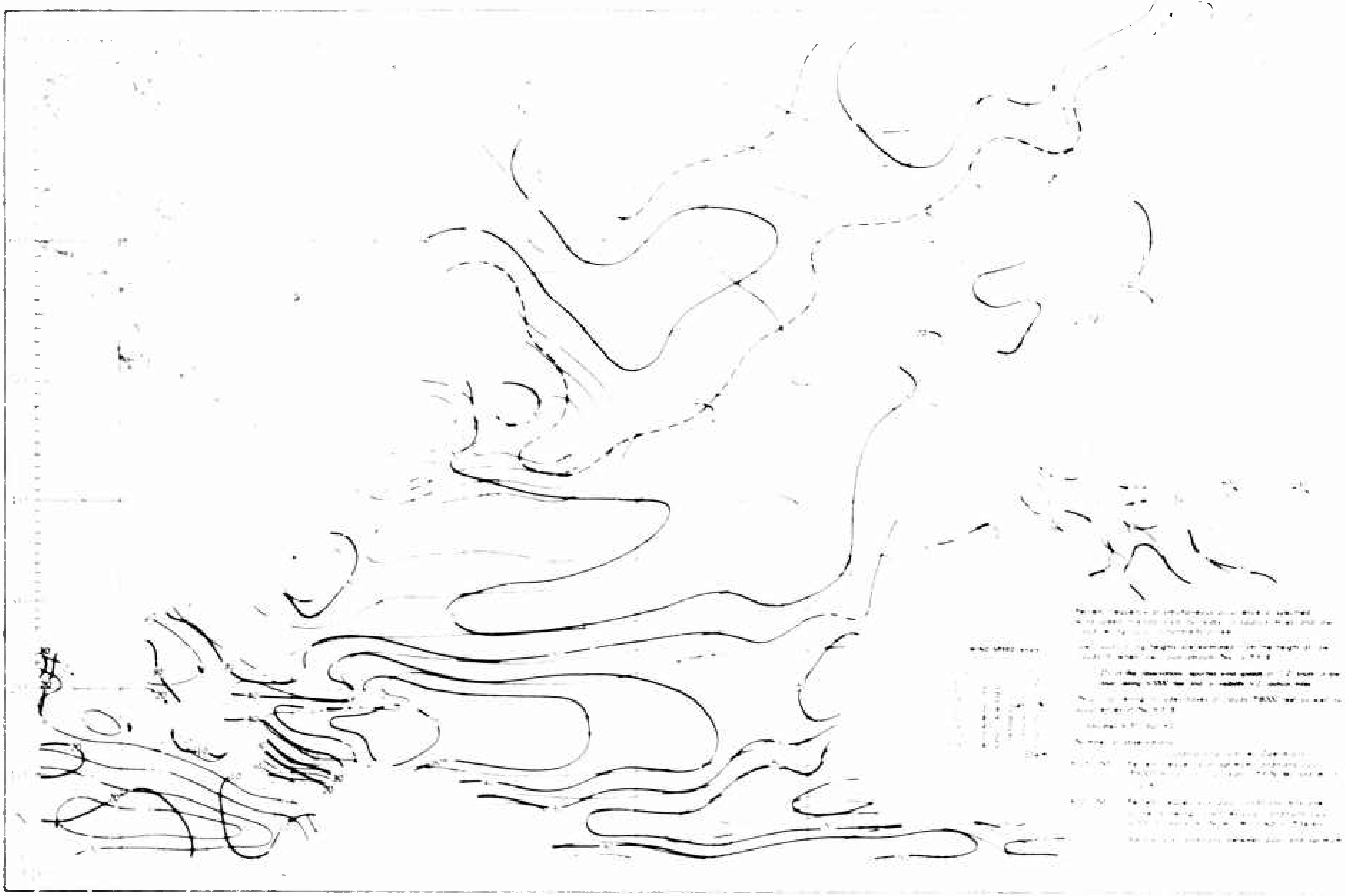
JUNE

CEILING AND VISIBILITY



INSUFFICIENT
DATA

WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

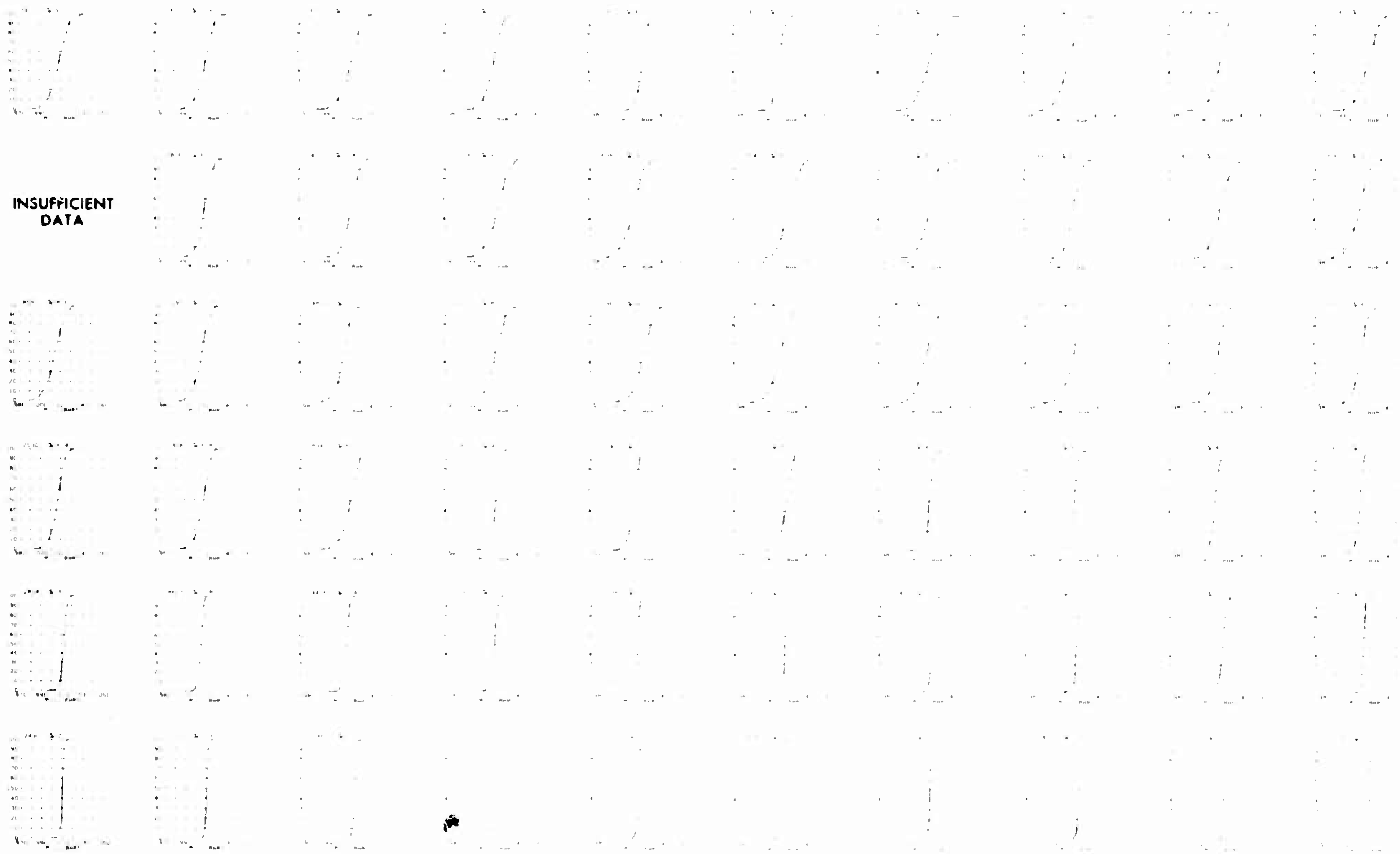
JUNE

INSUFFICIENT DATA

JUNE SEA-LEVEL PRESSURE AND MEAN WIND

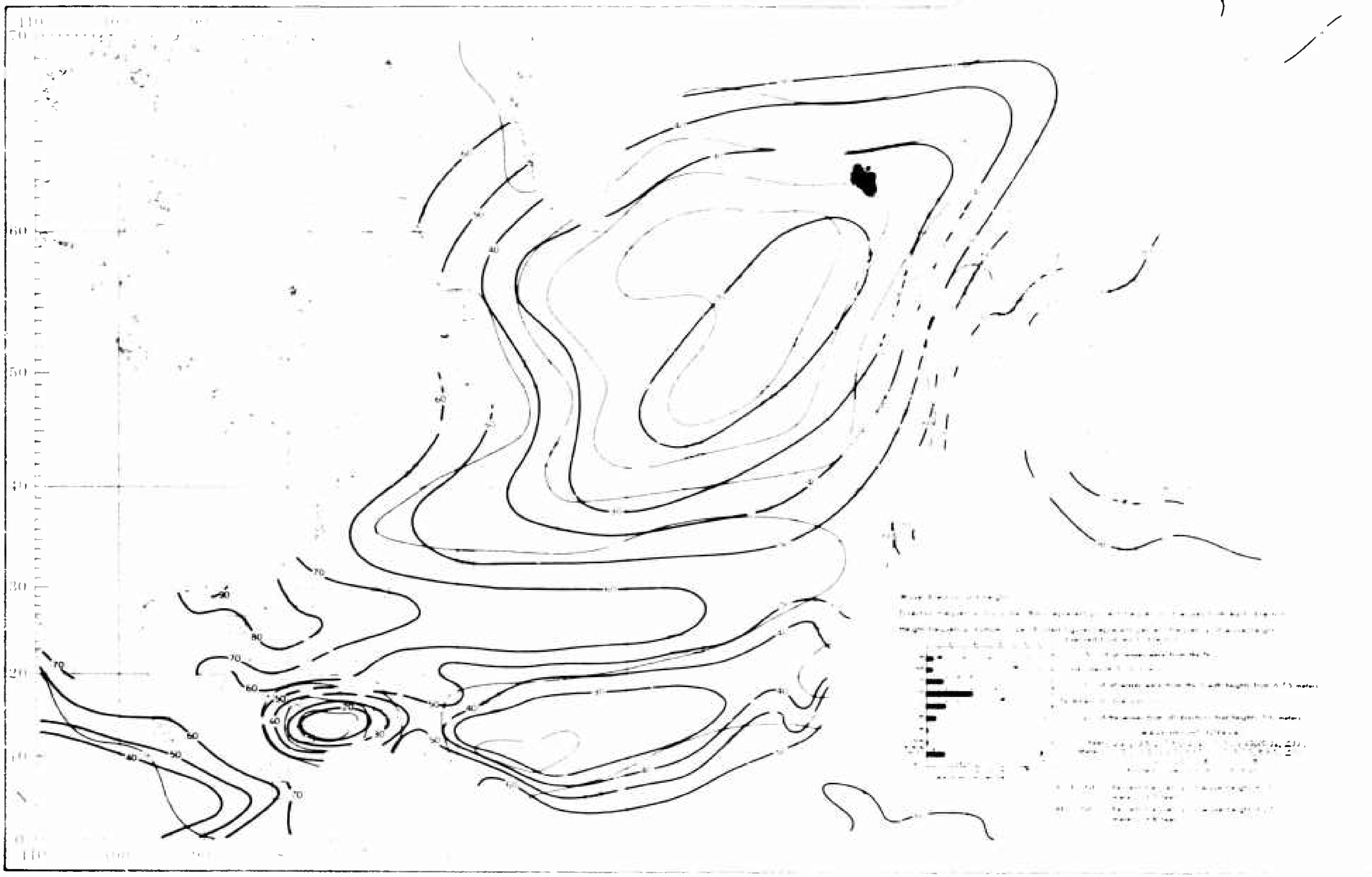
SEA LEVEL PRESSURE

JUNE



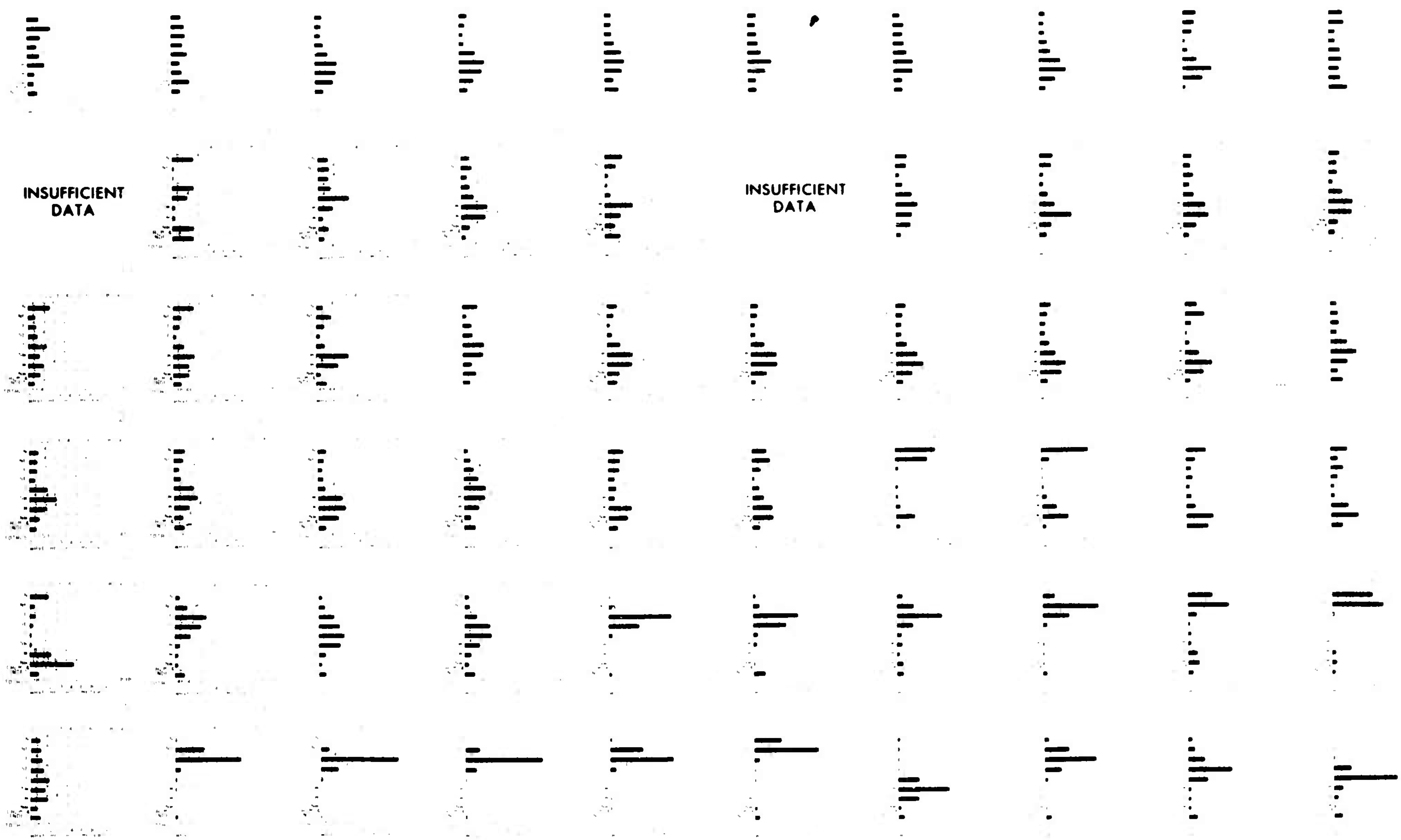
JUNE

WAVES (<1.5 AND <2.5 METERS)



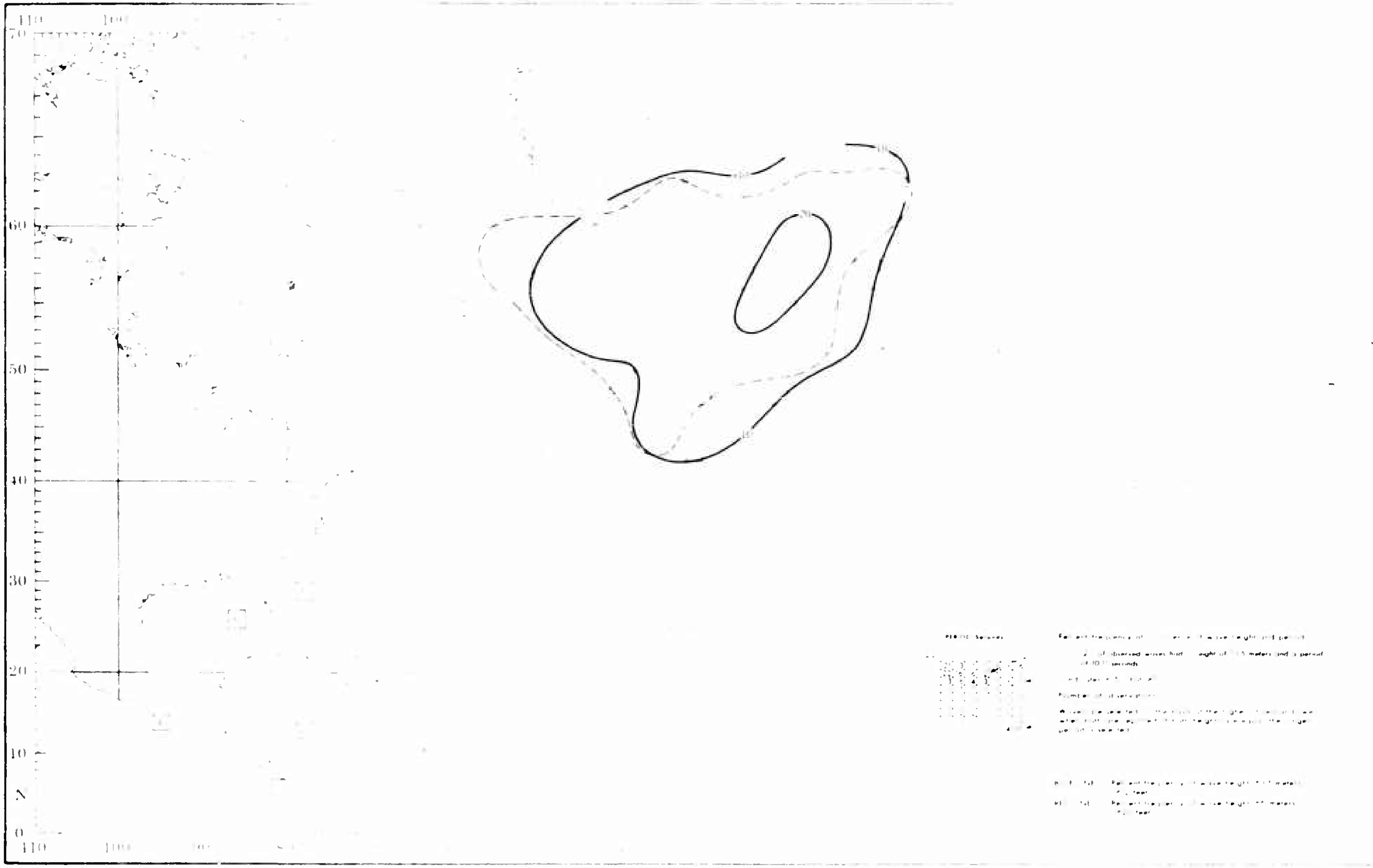
WAVE DIRECTION AND HEIGHT

JUNE



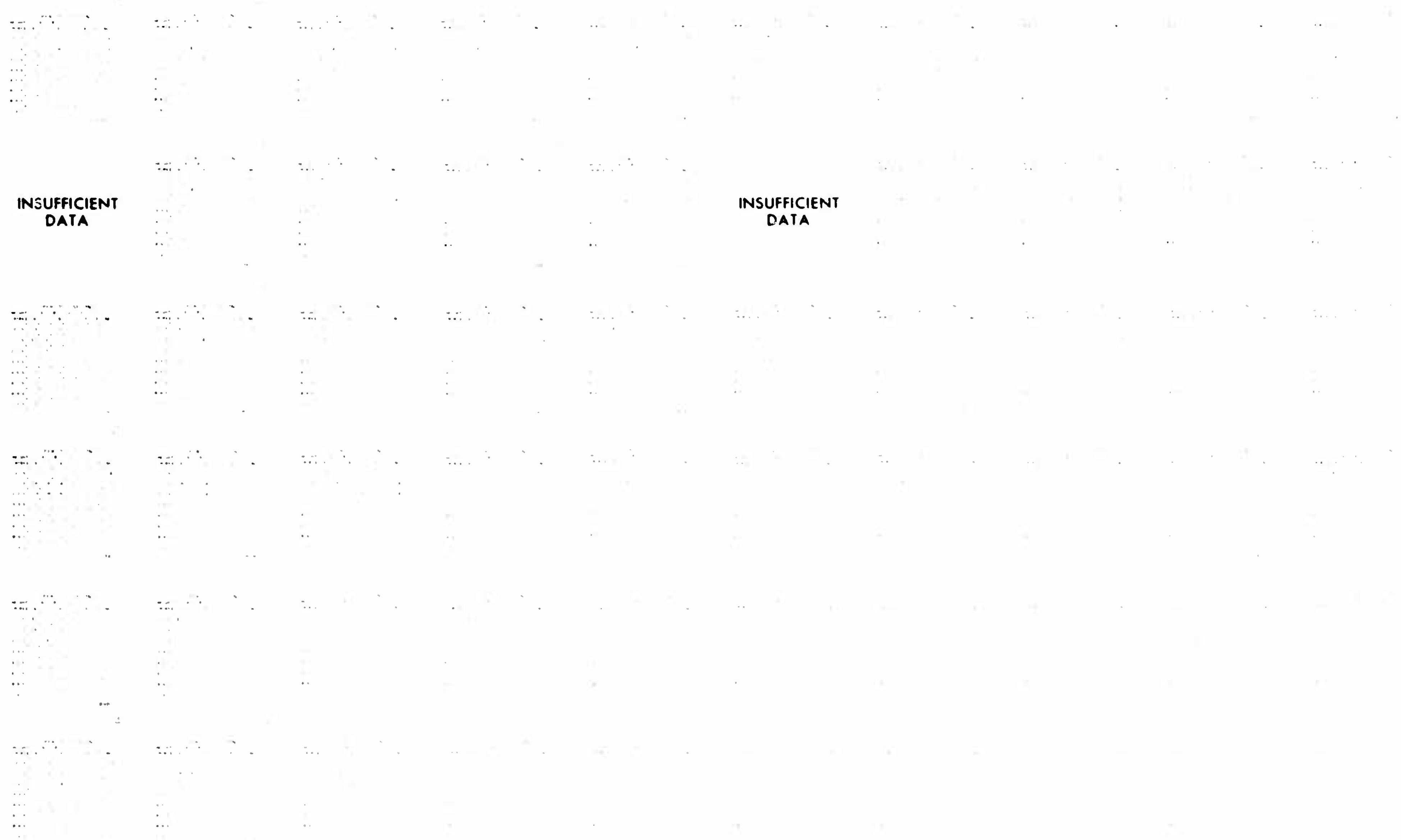
JUNE

WAVES (≥3.5 AND ≥6 METERS)



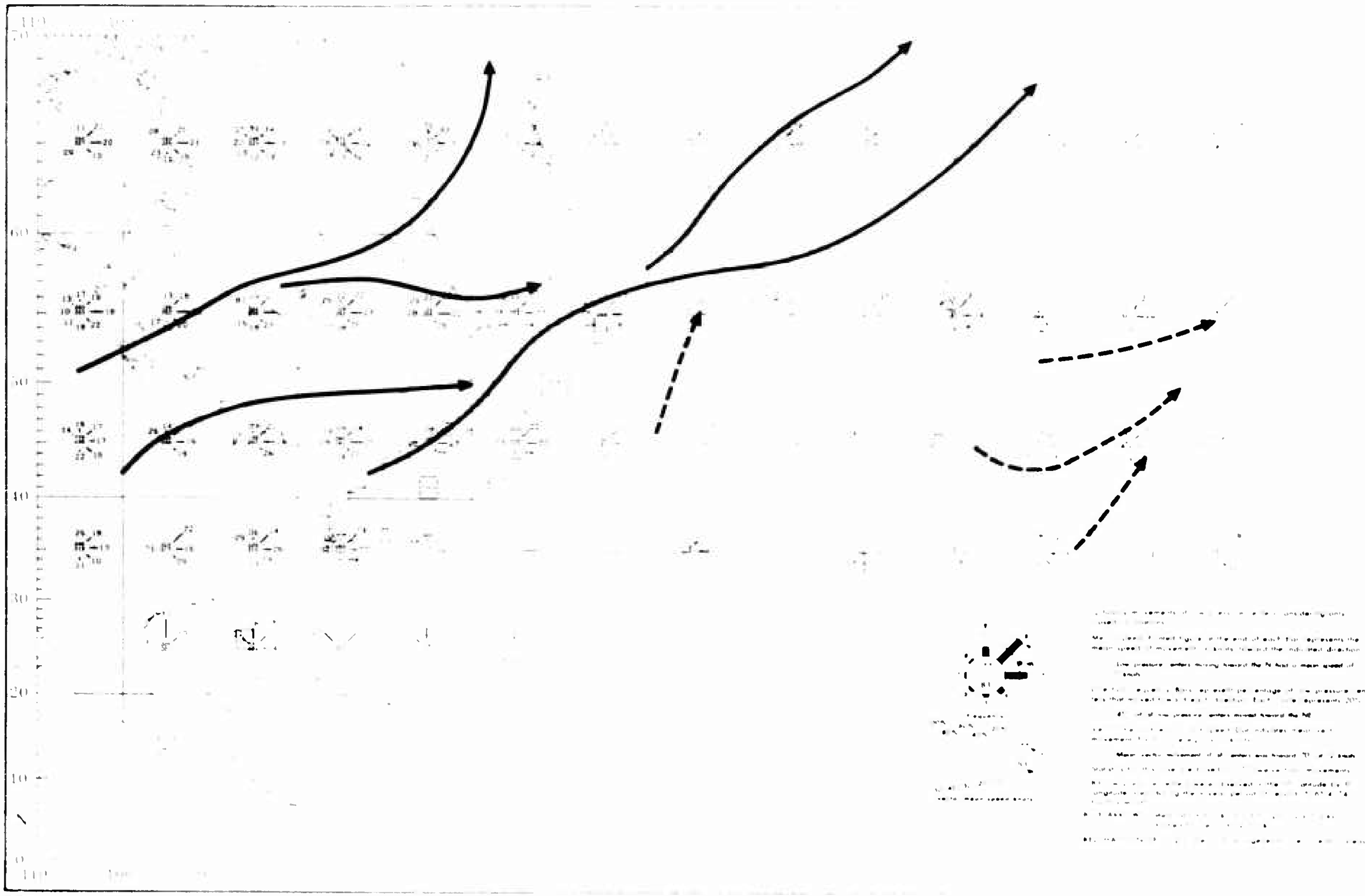
WAVE PERIOD AND HEIGHT

JUNE



JUNE

LOW PRESSURE CENTERS



TROPICAL CYCLONE

JUNE

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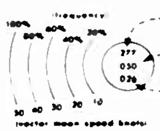

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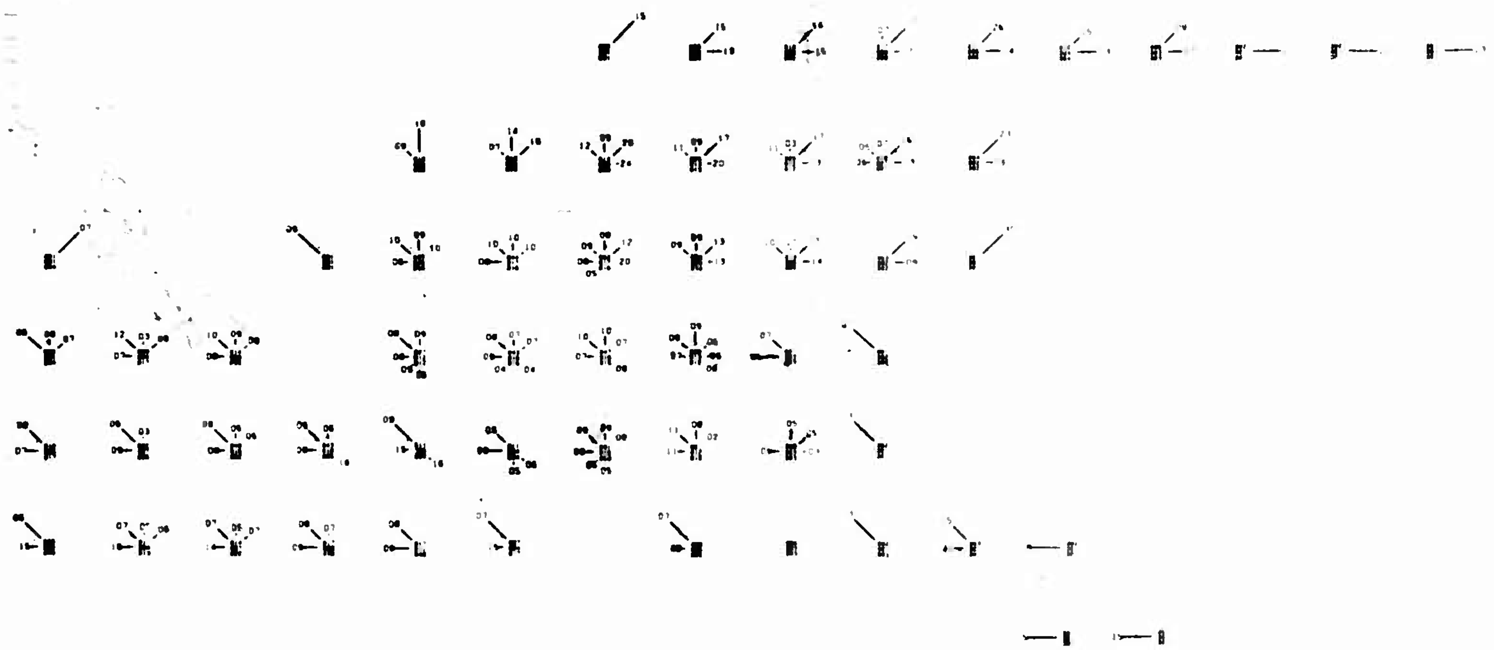
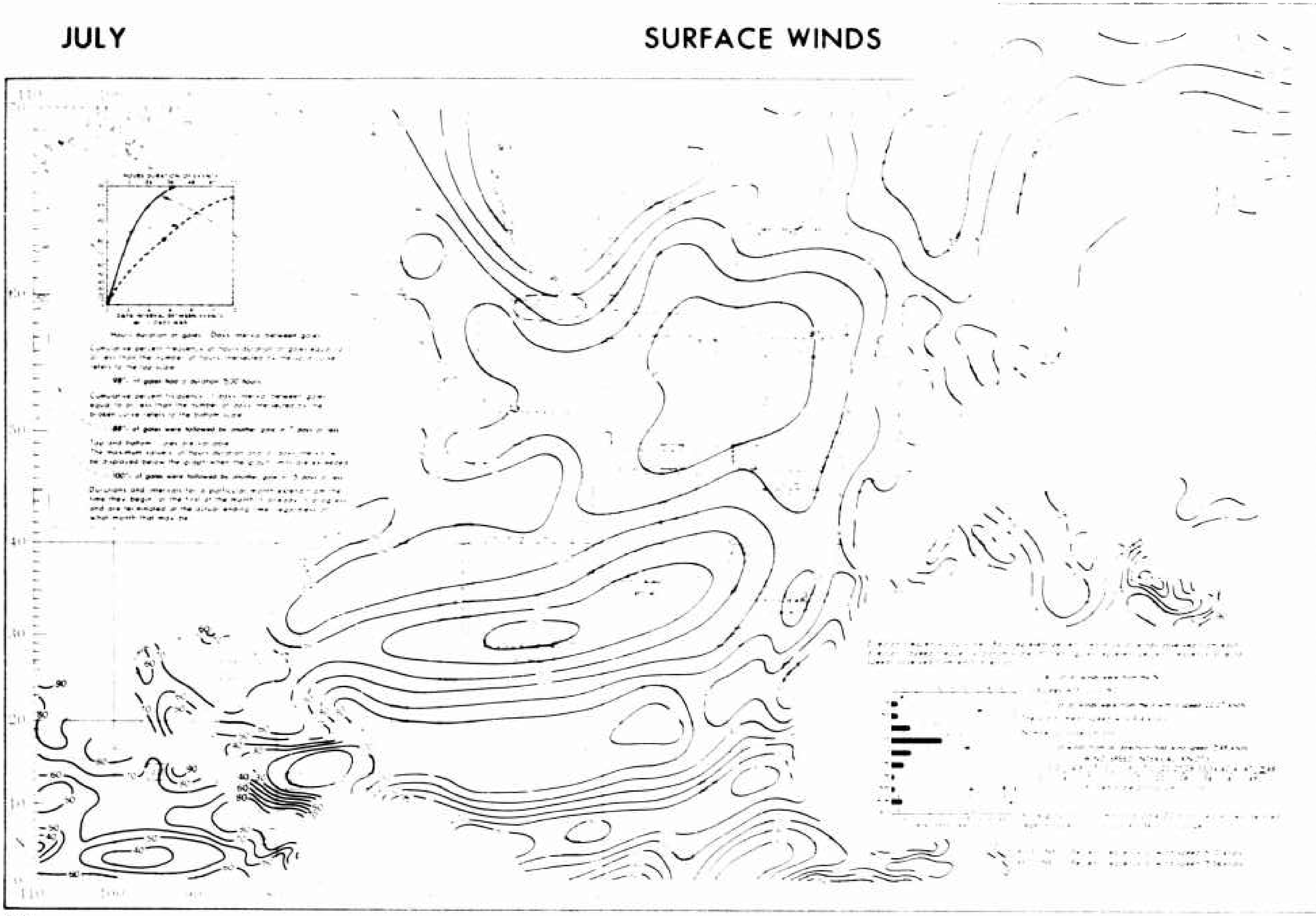
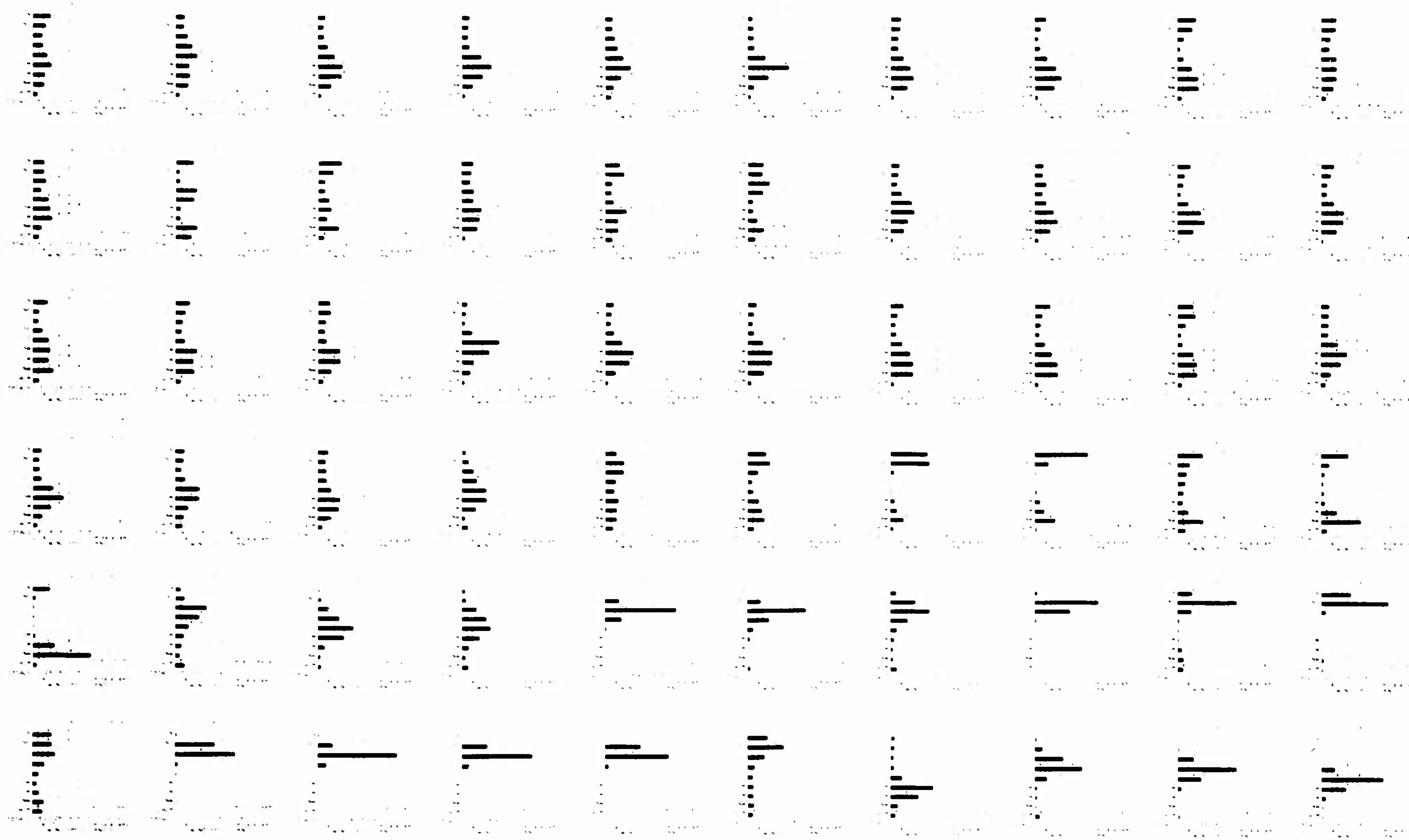


JULY SURFACE WINDS



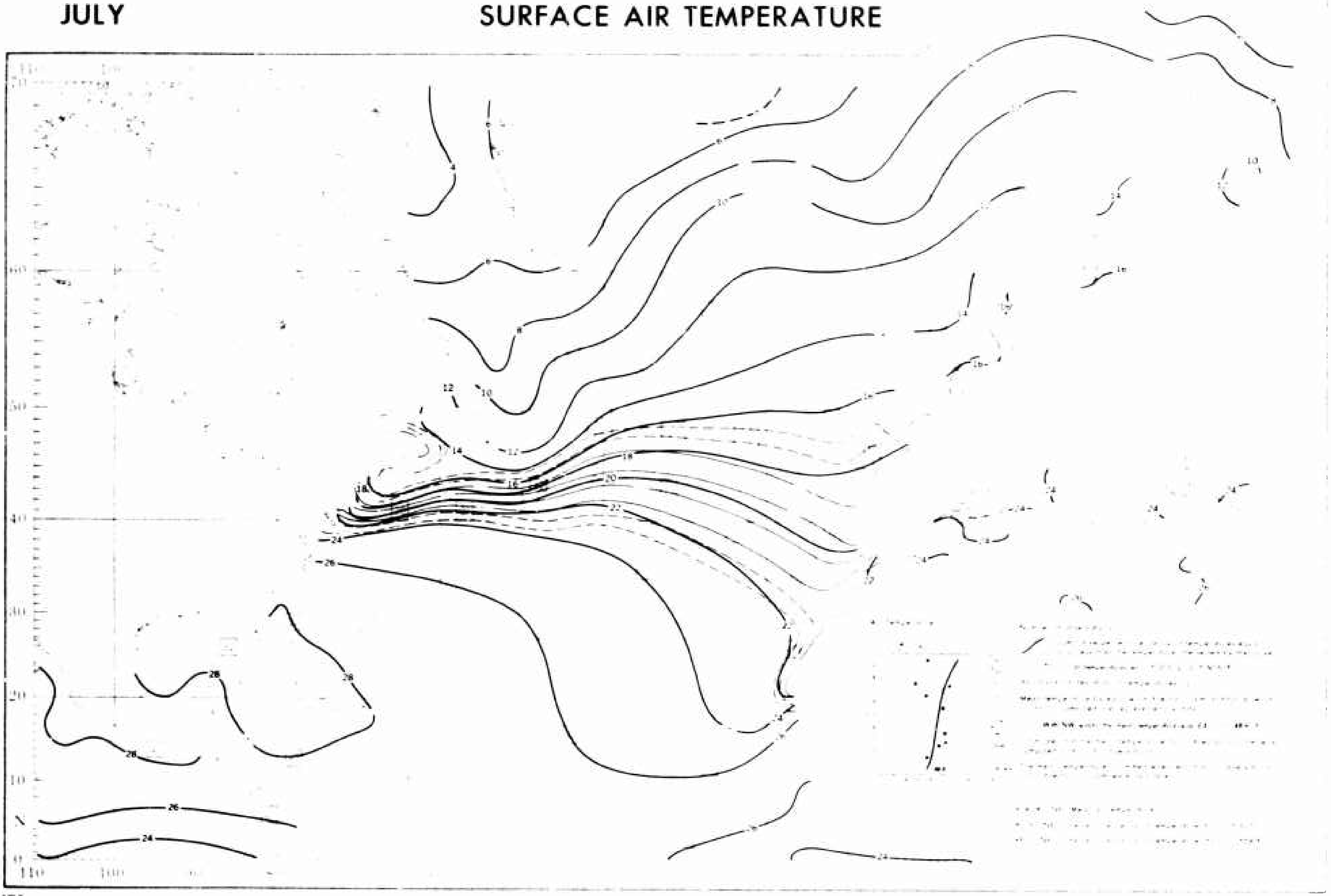
WIND DIRECTION AND SPEED

JULY



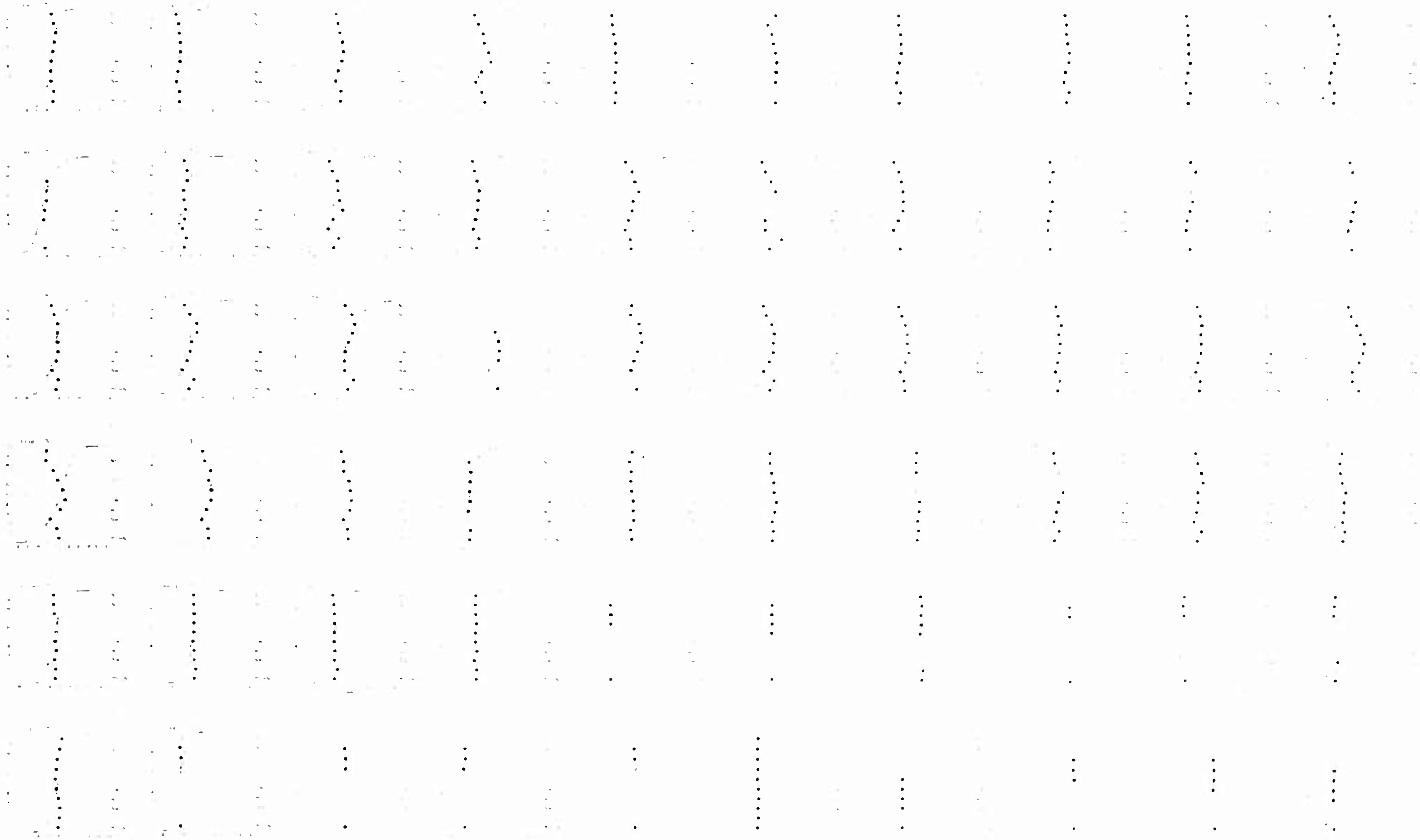
JULY

SURFACE AIR TEMPERATURE

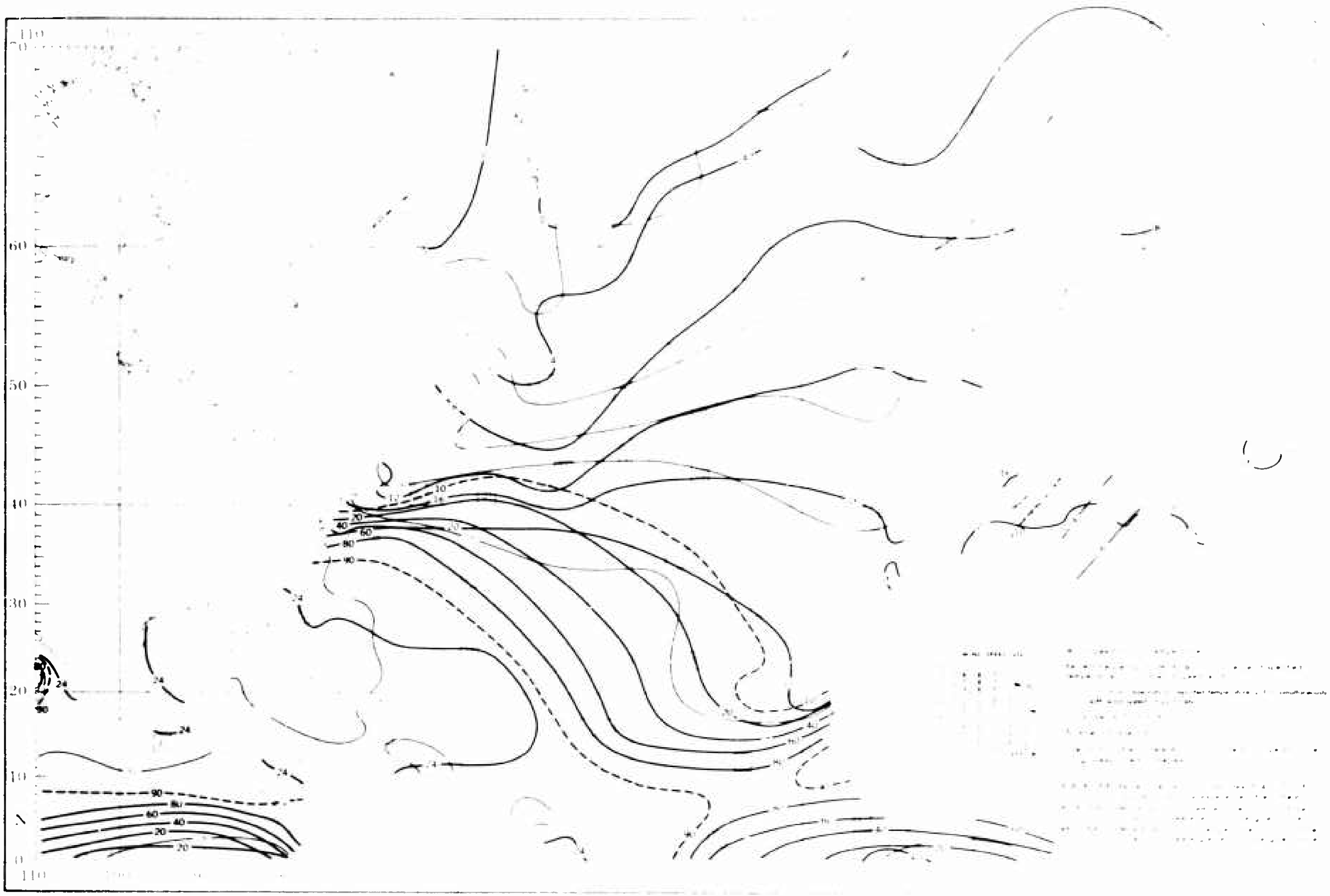


SURFACE AIR TEMPERATURE

JULY



JULY TEMPERATURE EXTREMES AND T-H INDEX

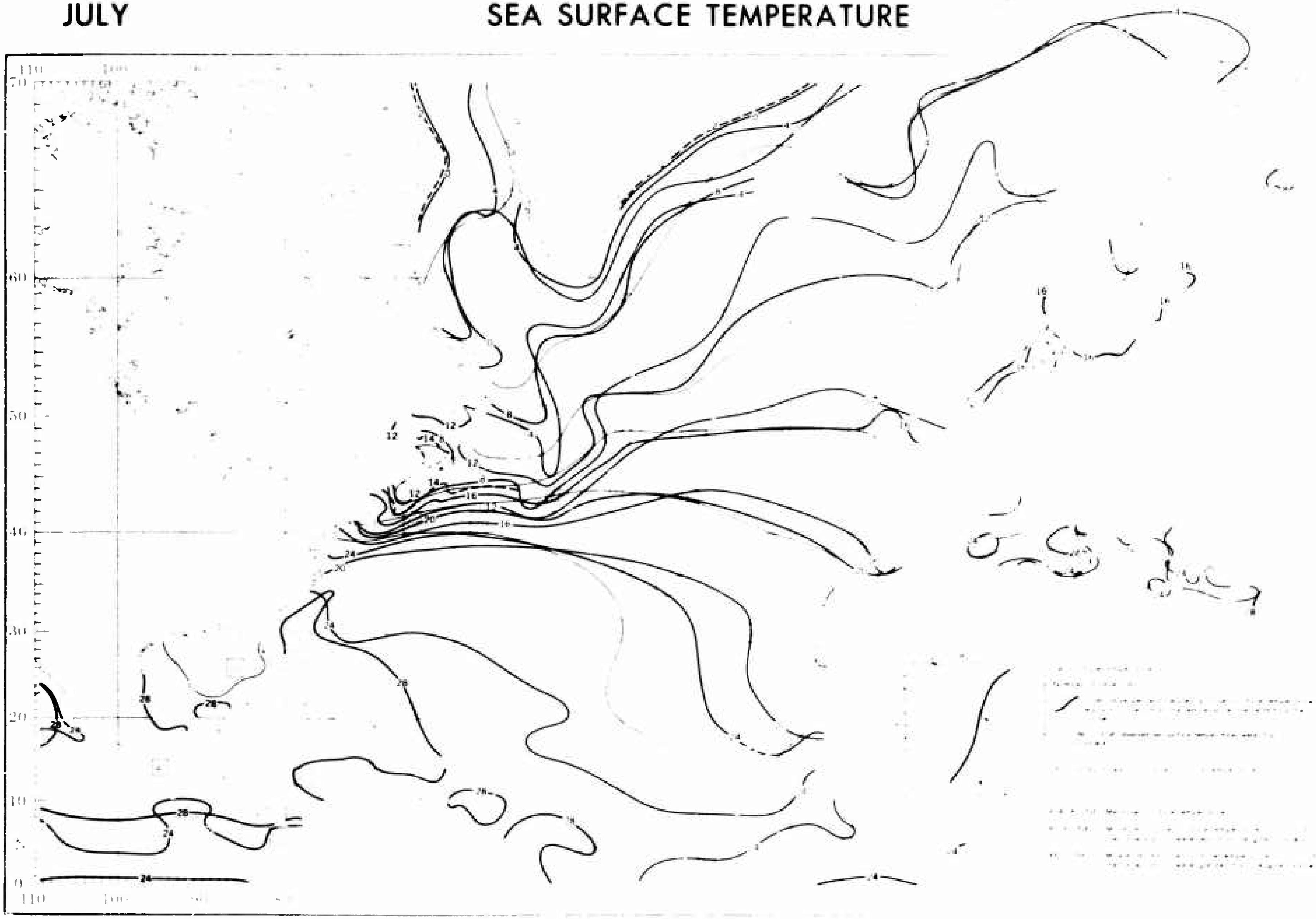


WIND SPEED AND AIR TEMPERATURE

JULY

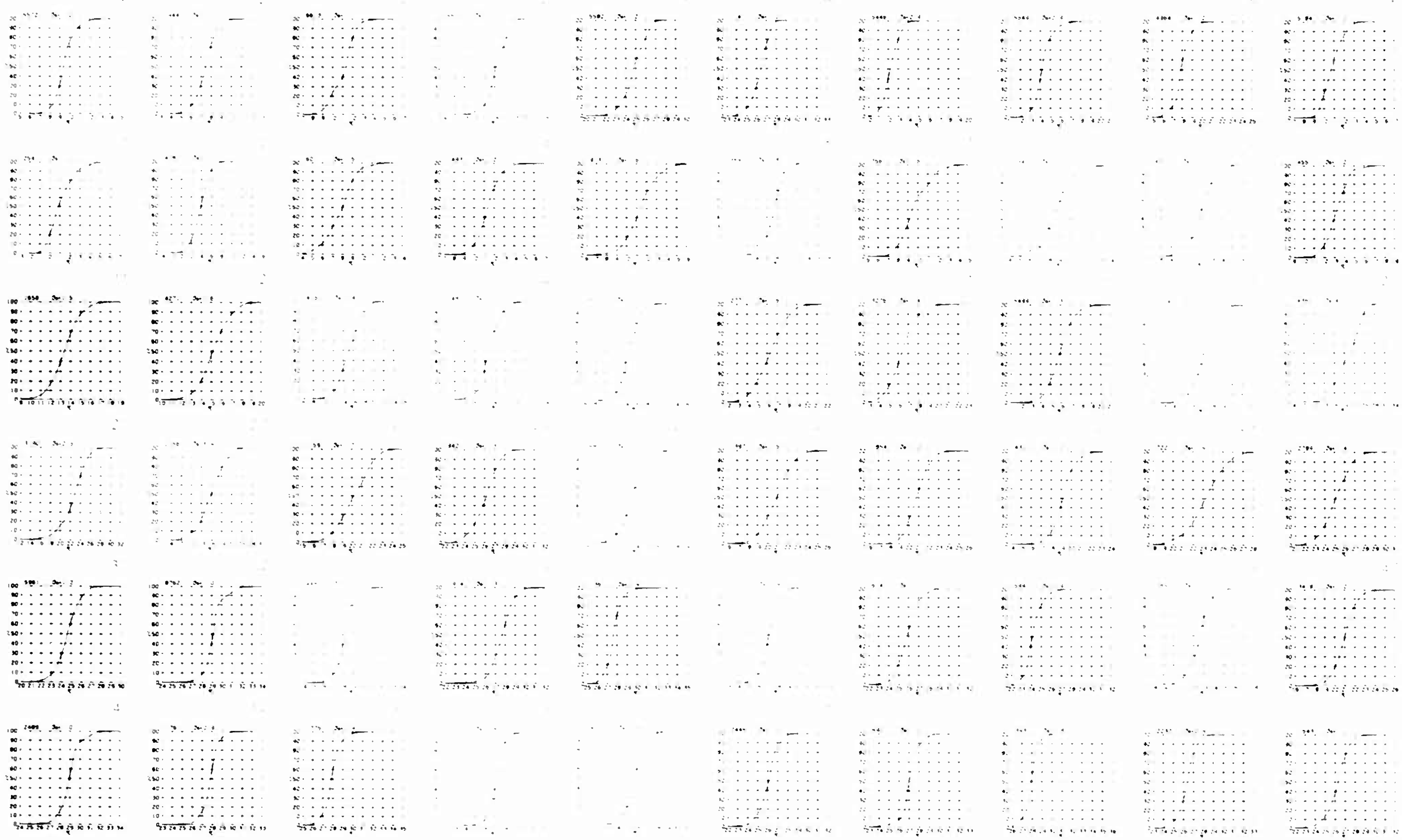
JULY

SEA SURFACE TEMPERATURE

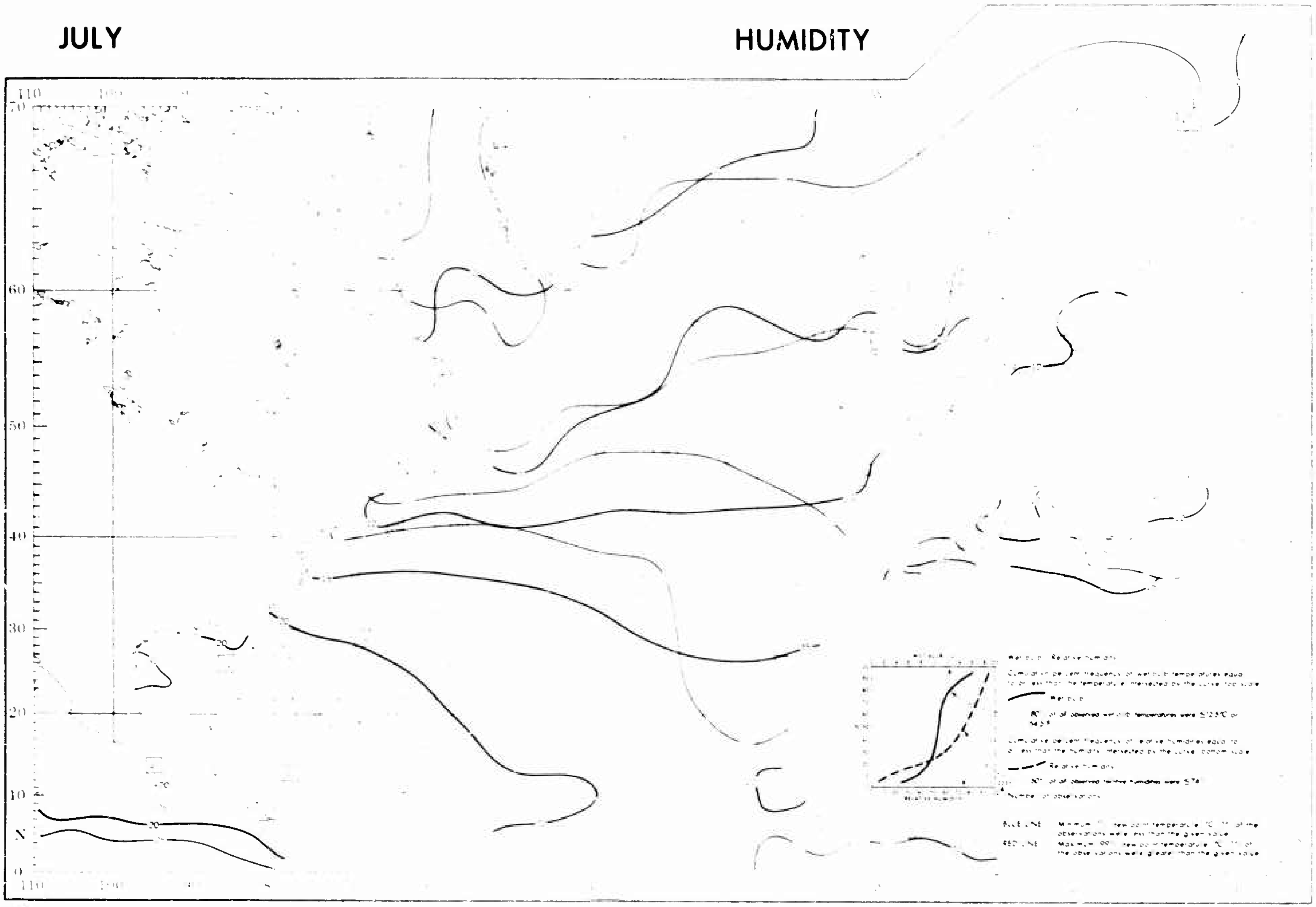


SEA SURFACE TEMPERATURE

JULY

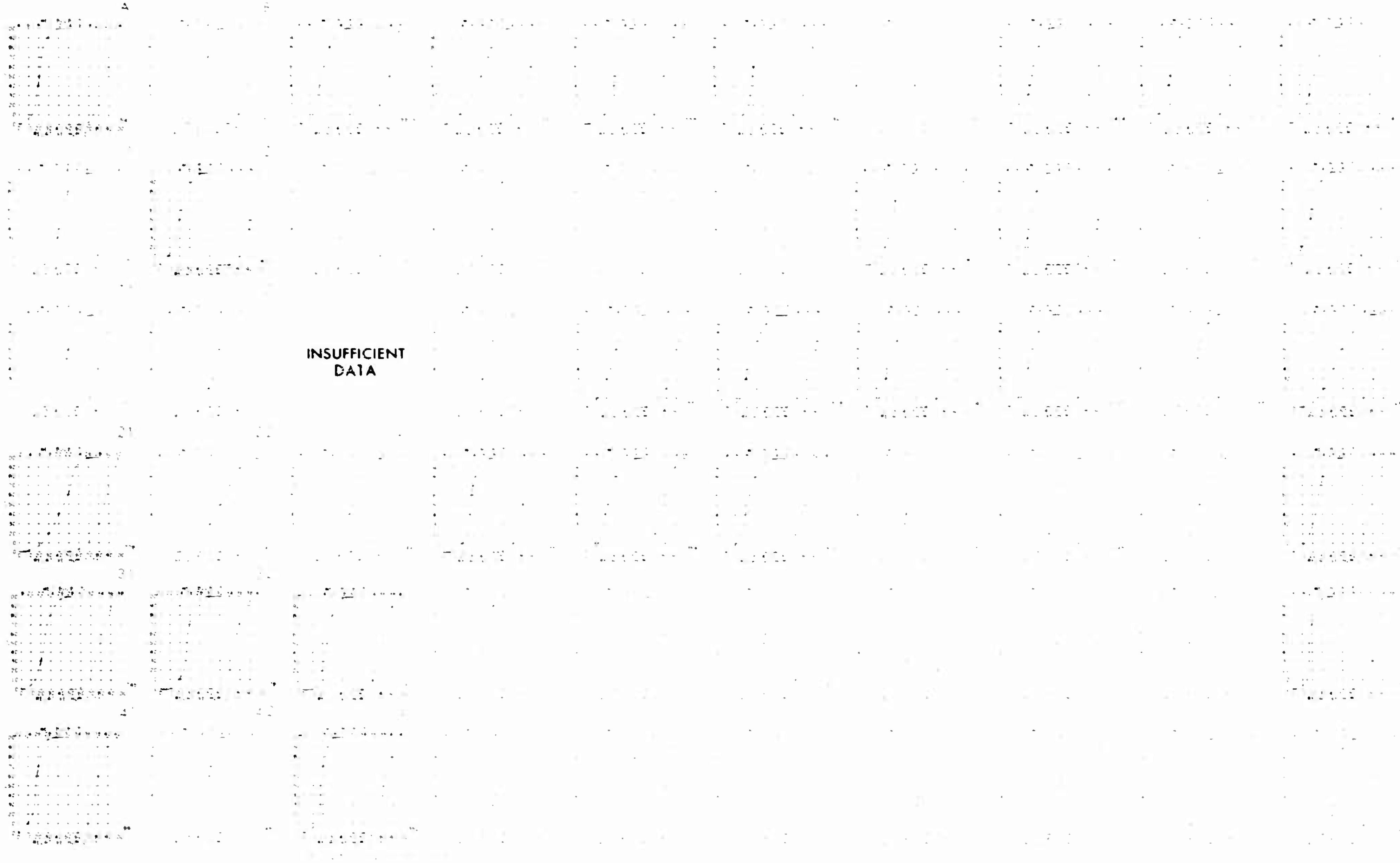


JULY HUMIDITY



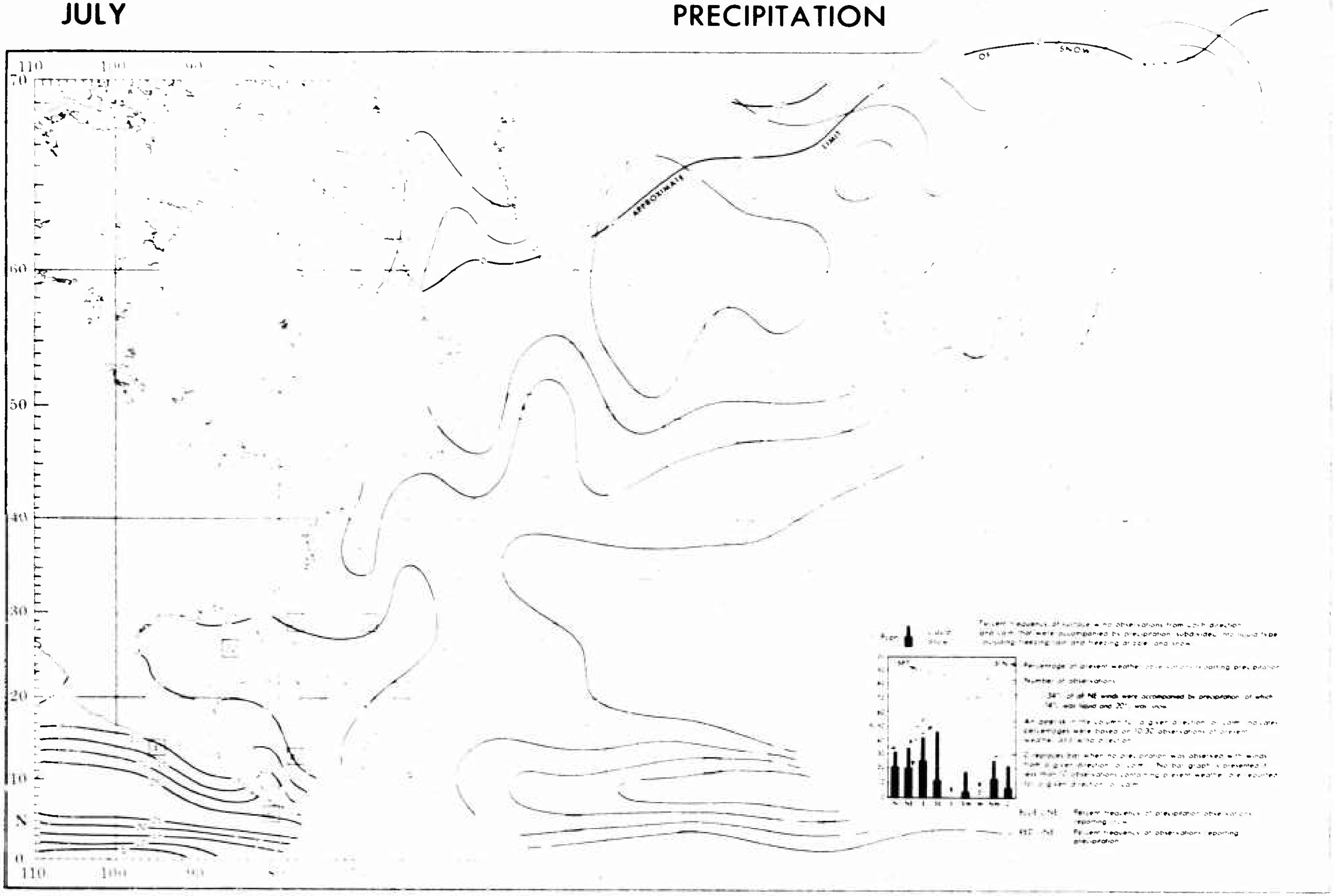
WET BULB AND RELATIVE HUMIDITY

JULY

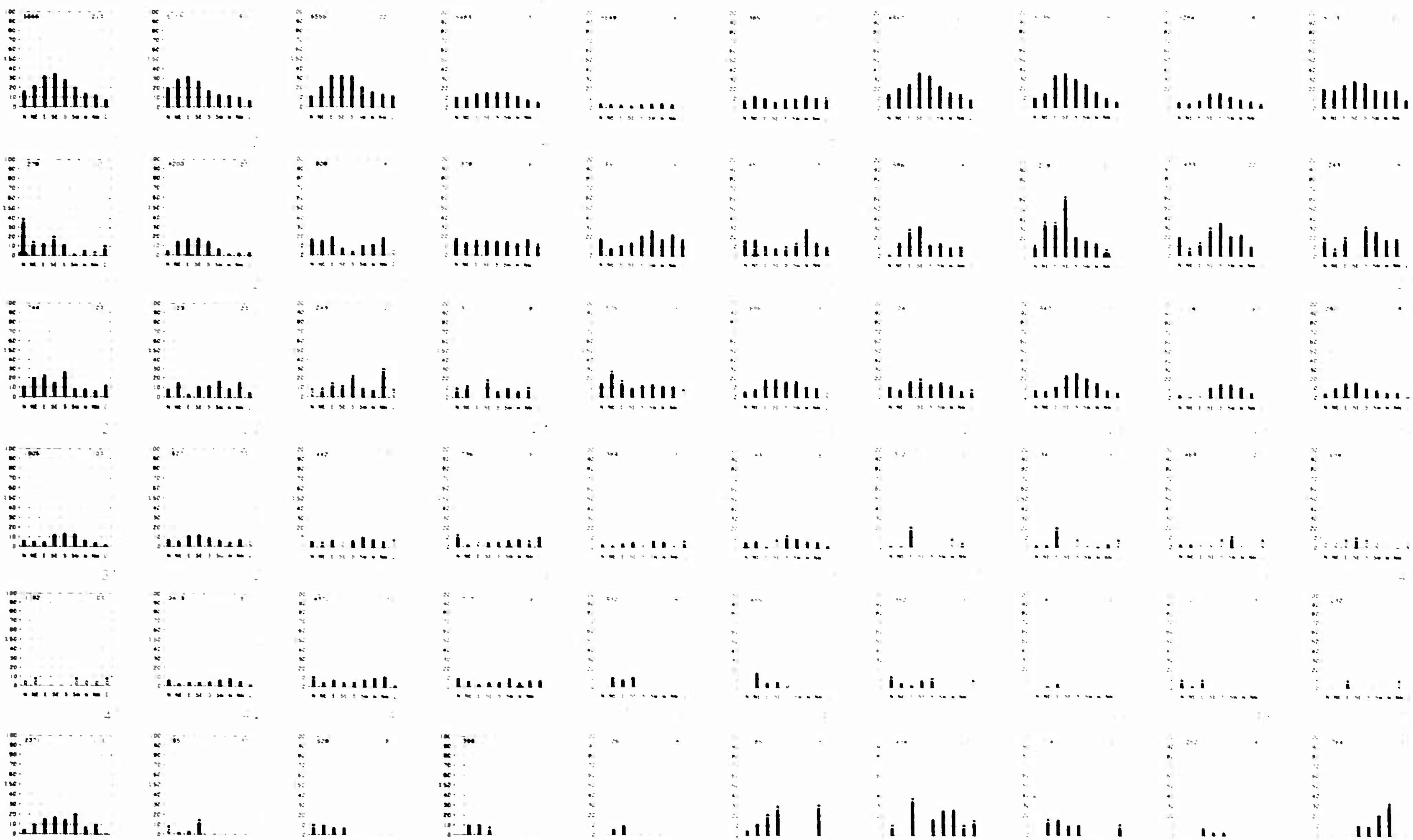


JULY

PRECIPITATION

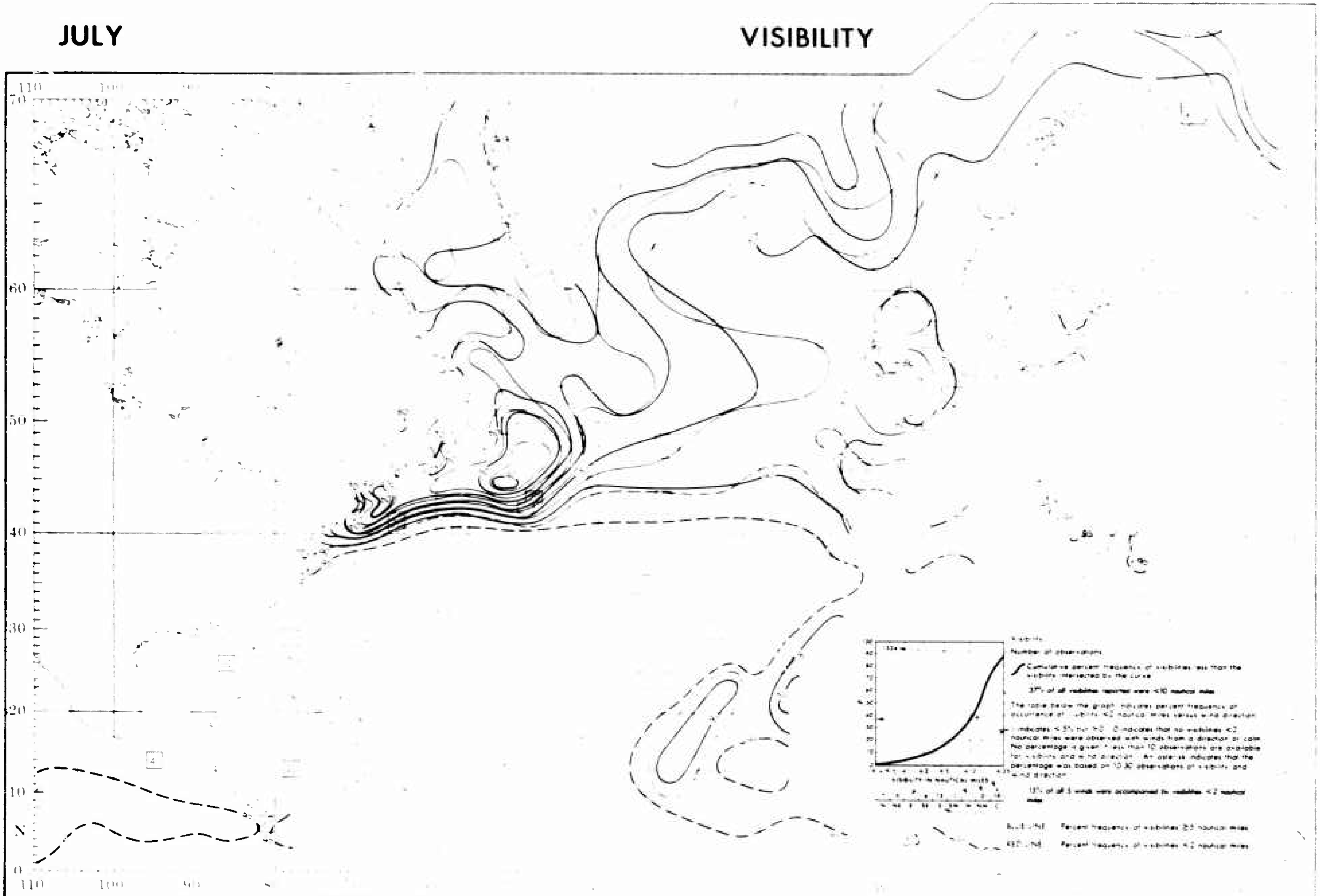


PRECIPITATION JULY



JULY

VISIBILITY

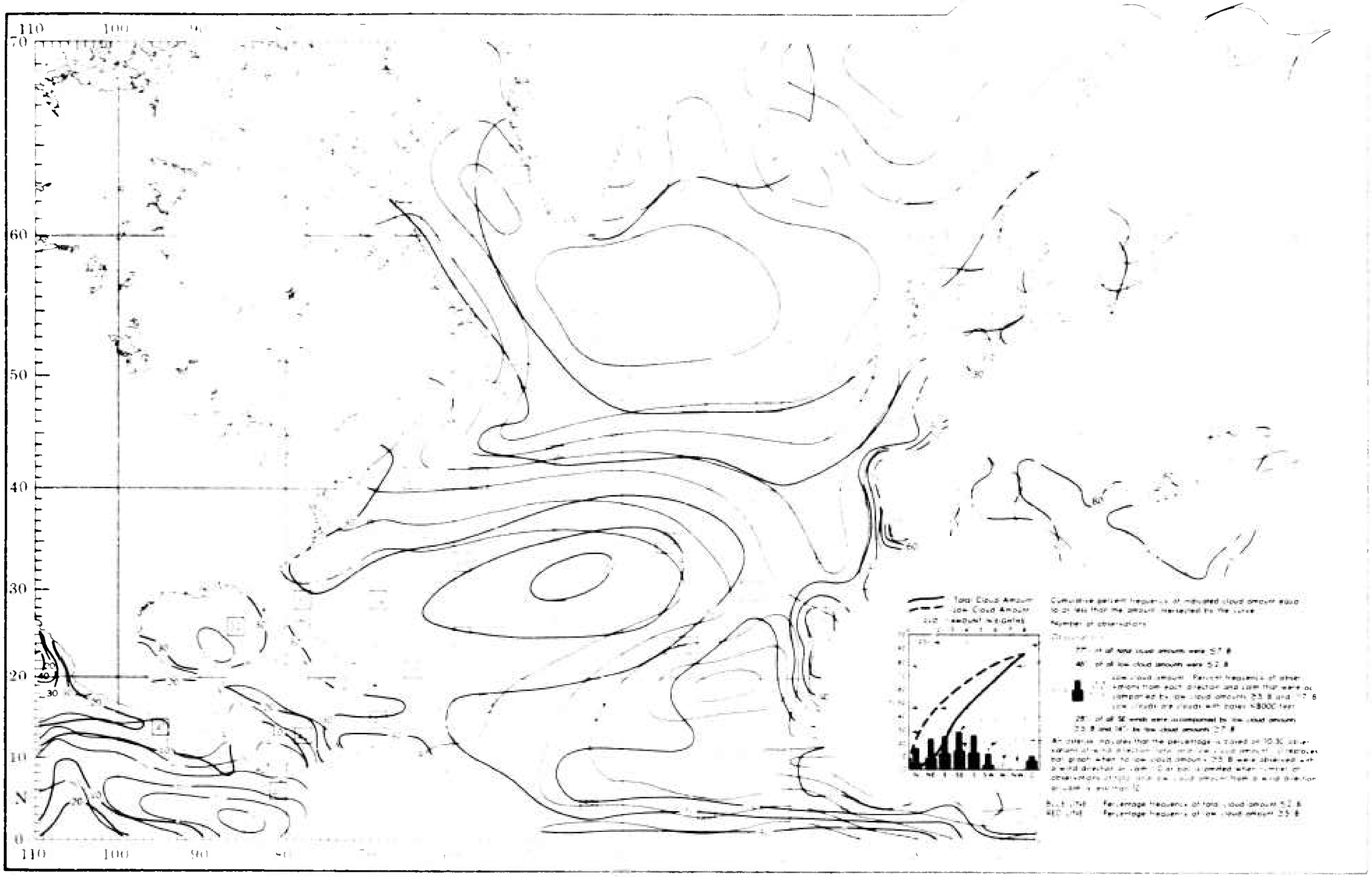


VISIBILITY

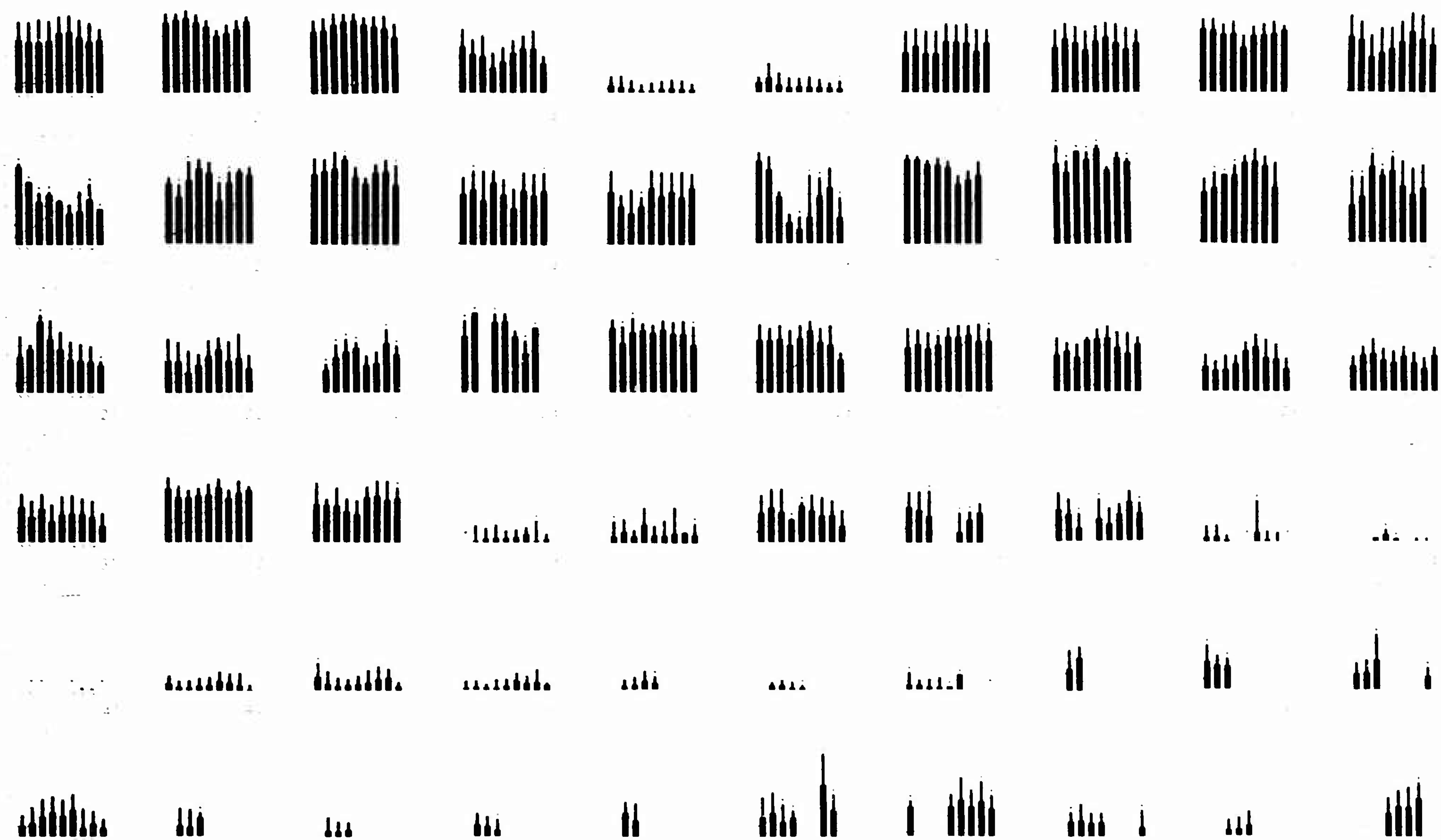
JULY

JULY

CLOUD COVER

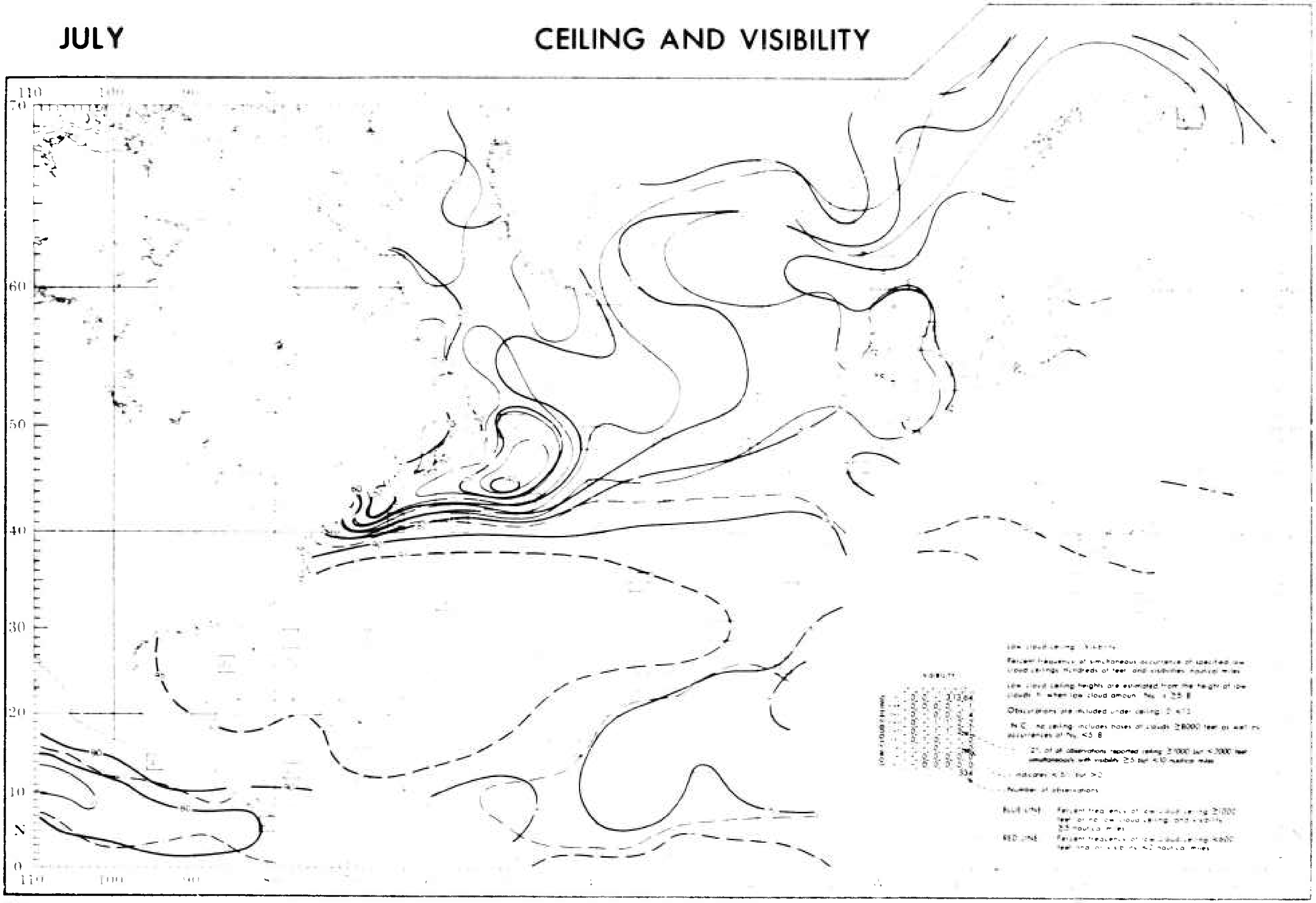


CLOUD COVER JULY



JULY

CEILING AND VISIBILITY

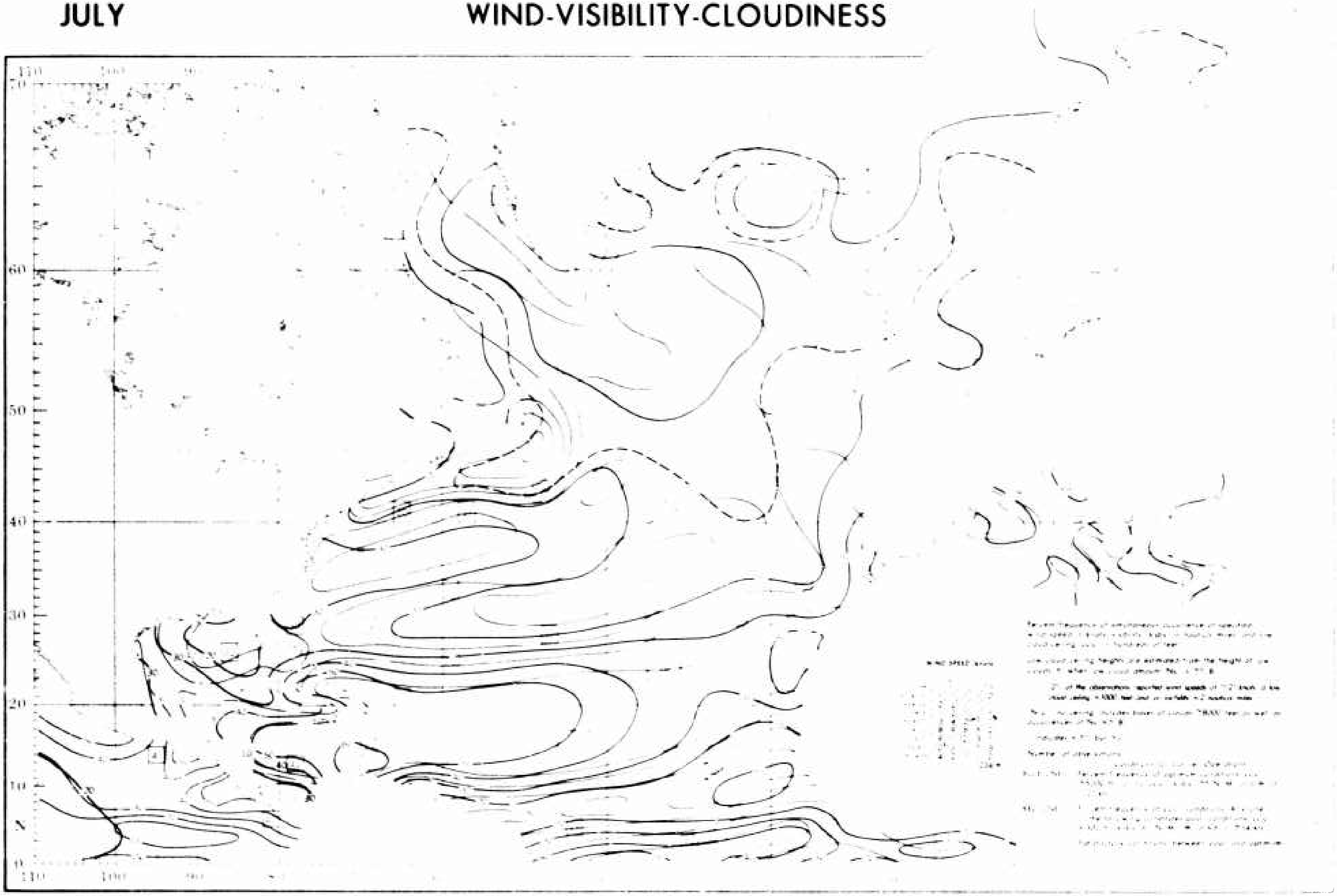


CEILING AND VISIBILITY

JULY

JULY

WIND-VISIBILITY-CLOUDINESS

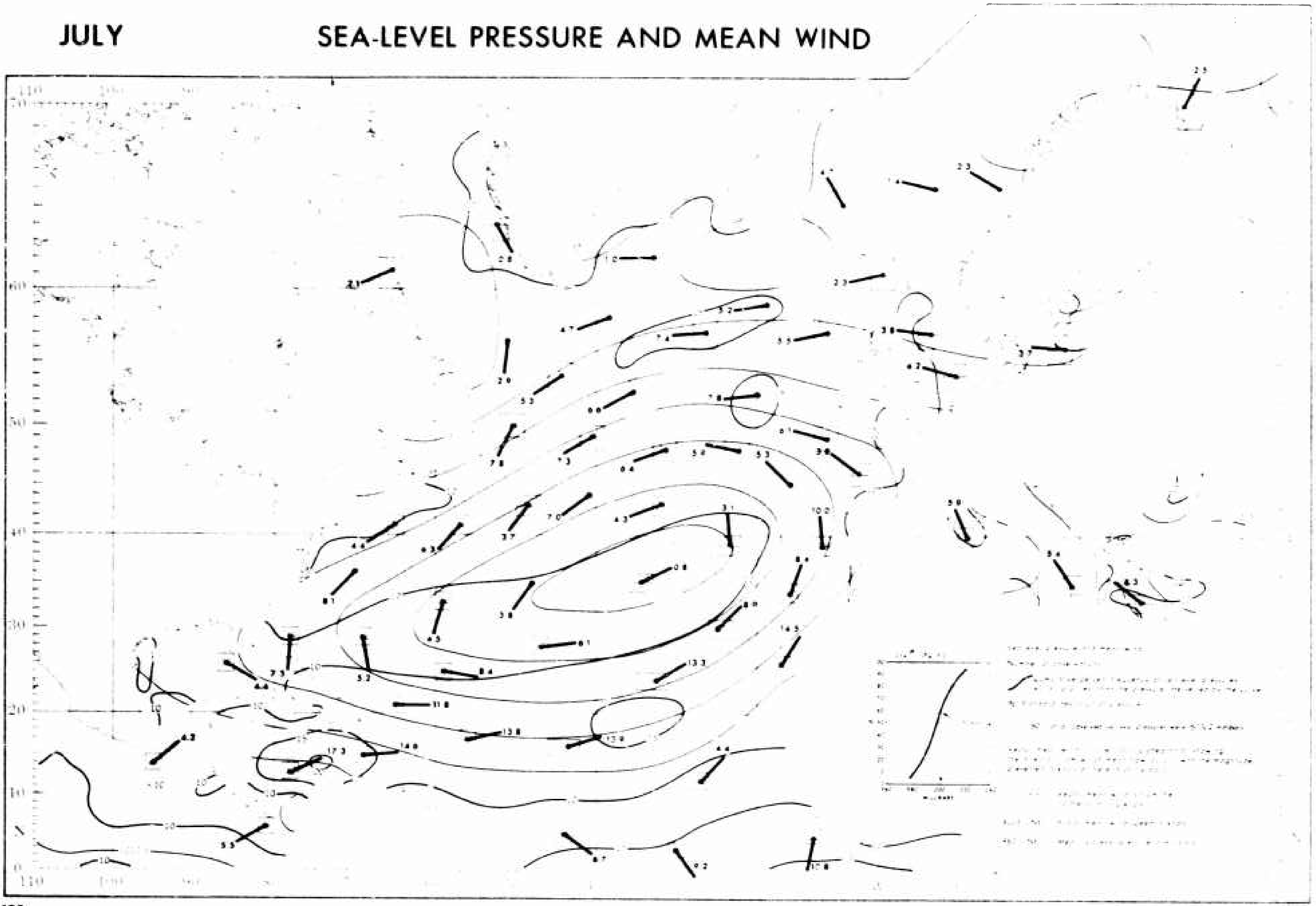


LOW CLOUD CEILING-VISIBILITY-WIND

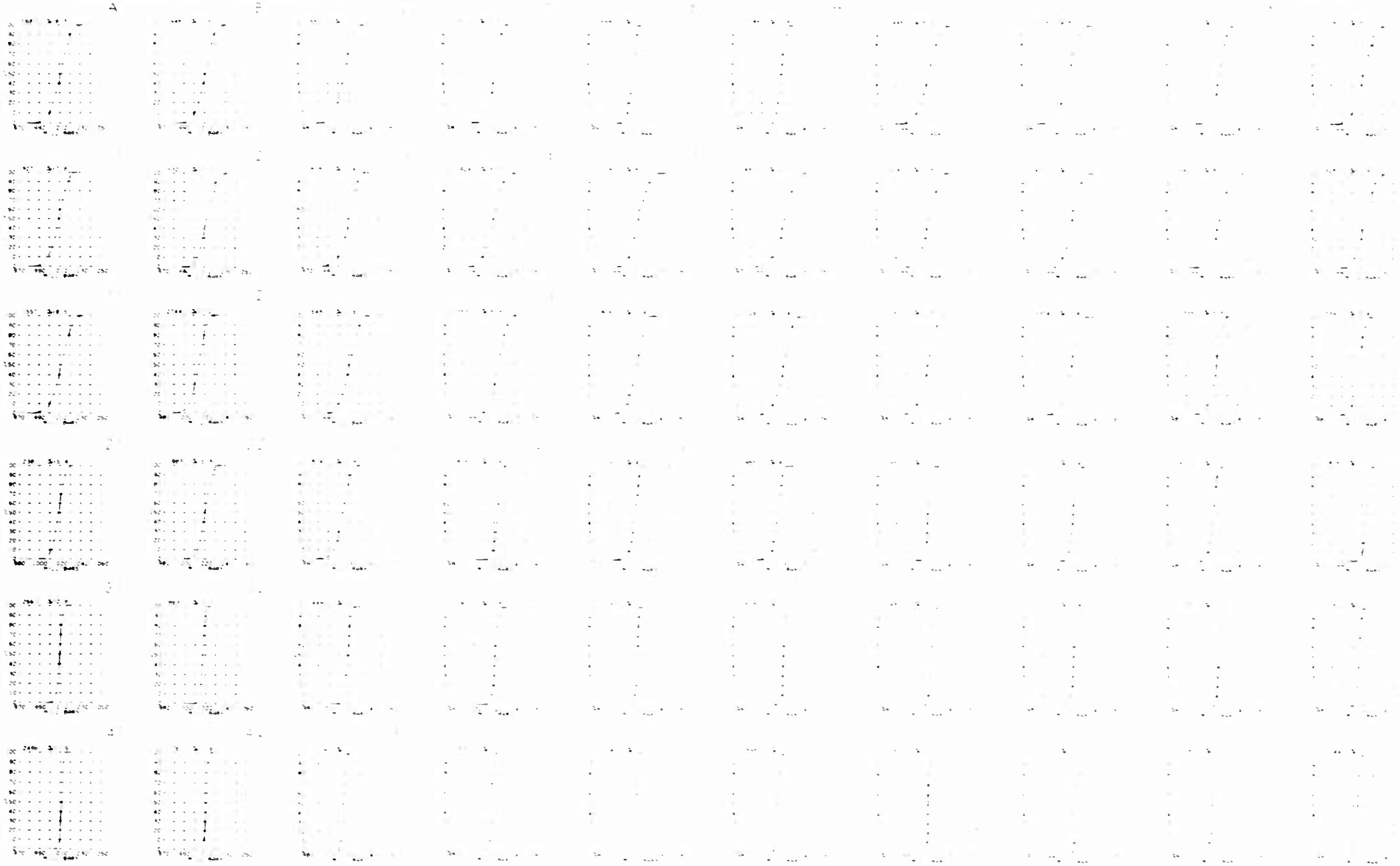
JULY

JULY

SEA-LEVEL PRESSURE AND MEAN WIND

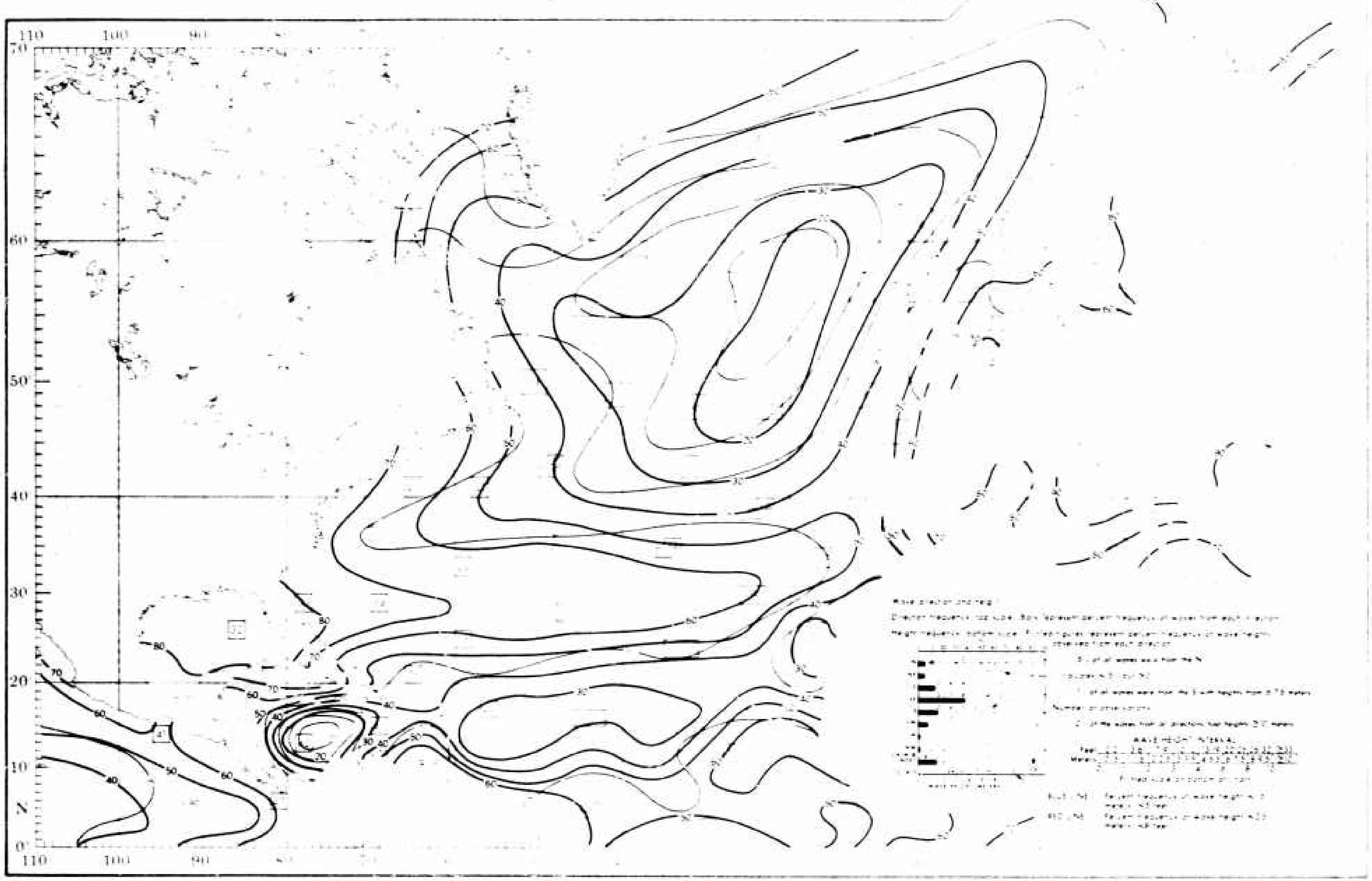


SEA LEVEL PRESSURE JULY



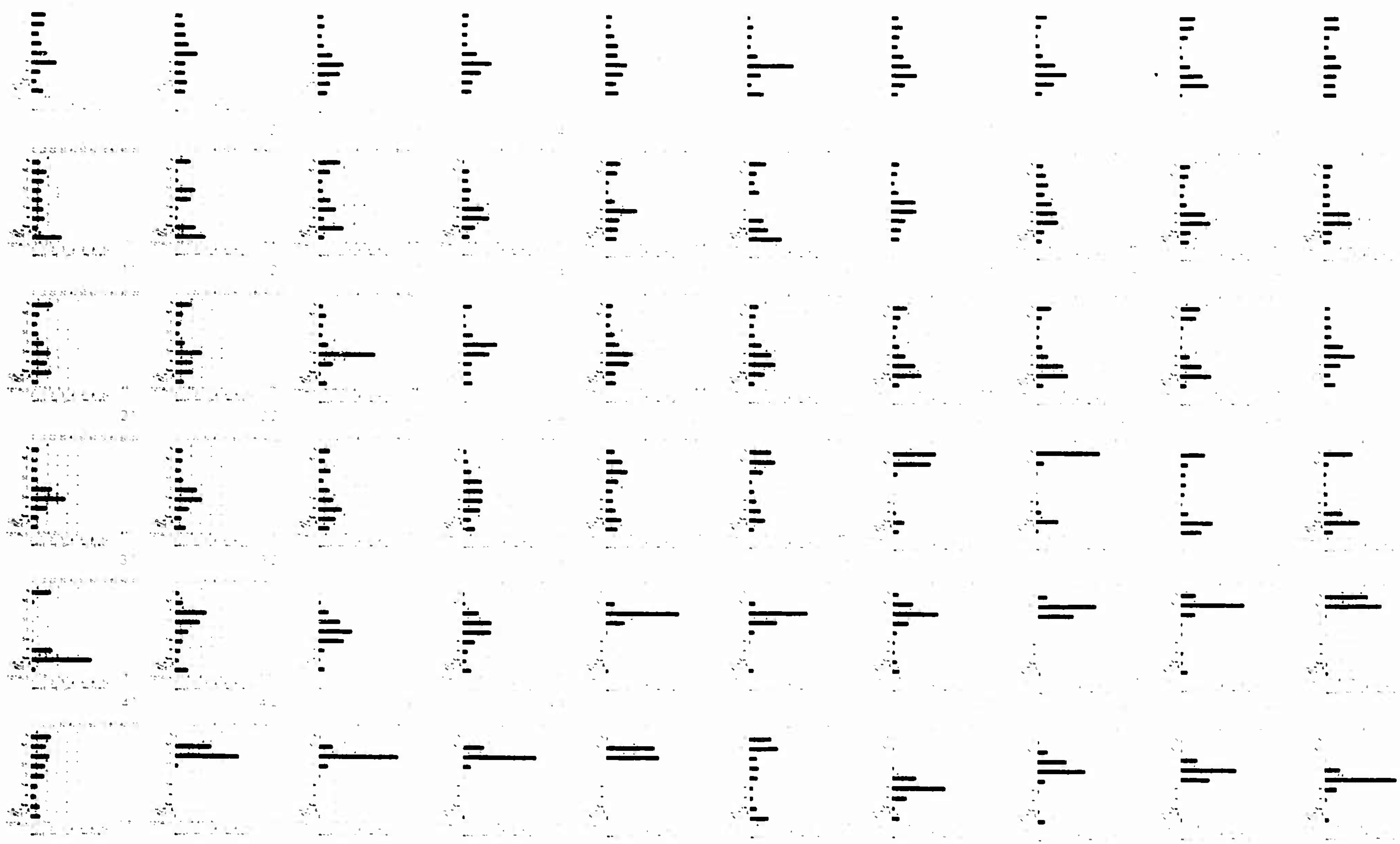
JULY

WAVES (<1.5 AND <2.5 METERS)



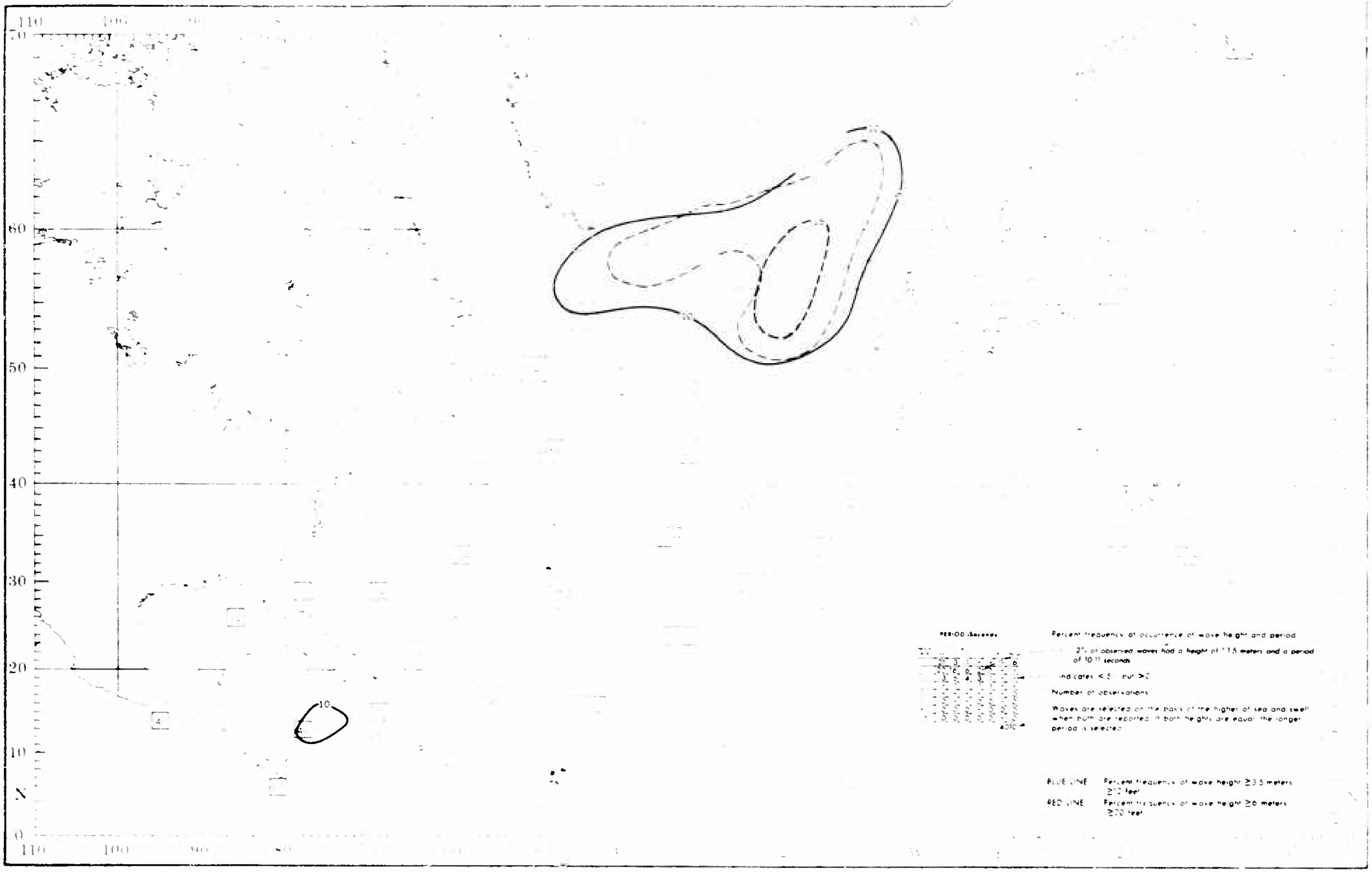
WAVE DIRECTION AND HEIGHT

JULY



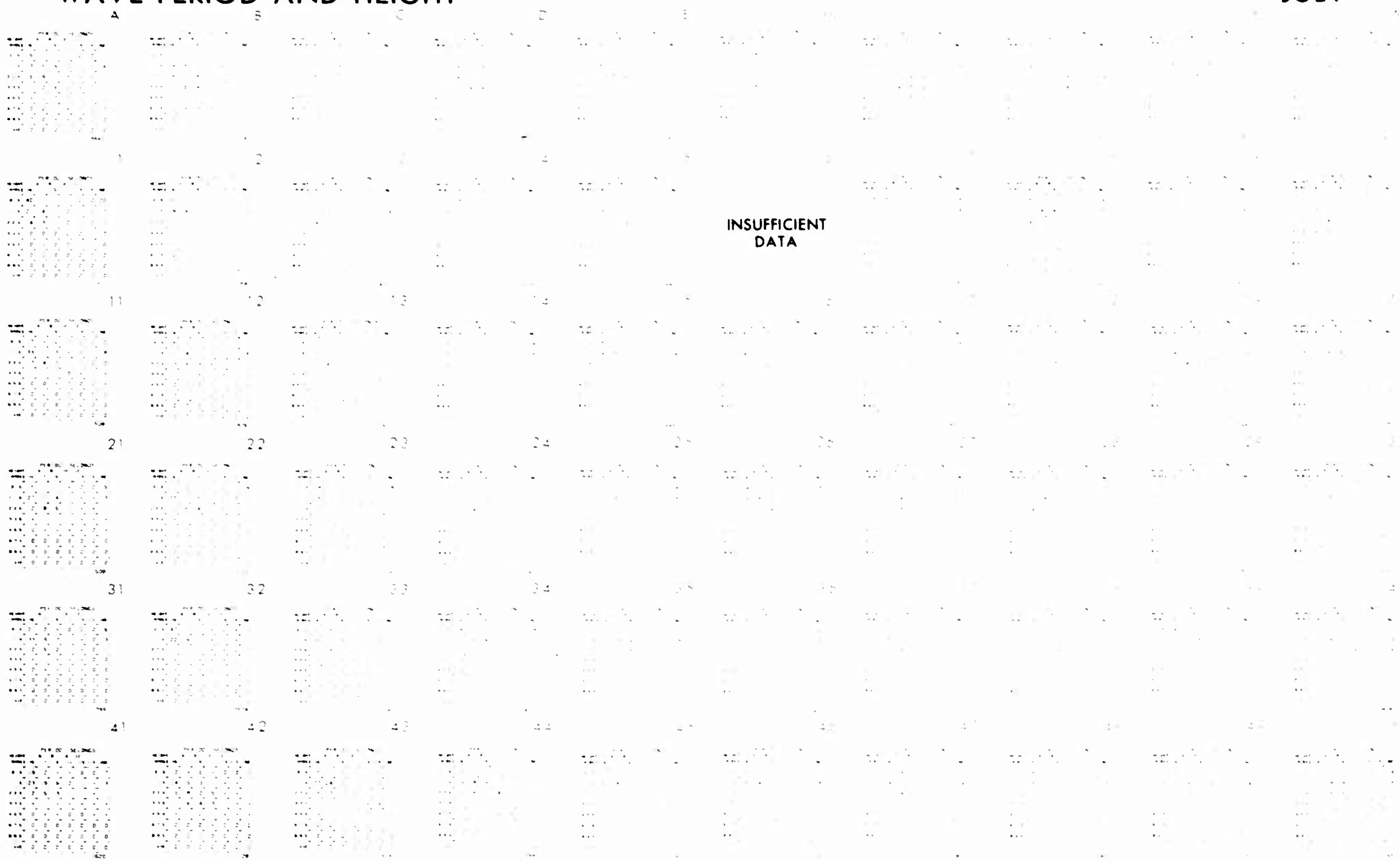
JULY

WAVES (≥3.5 AND ≥6 METERS)



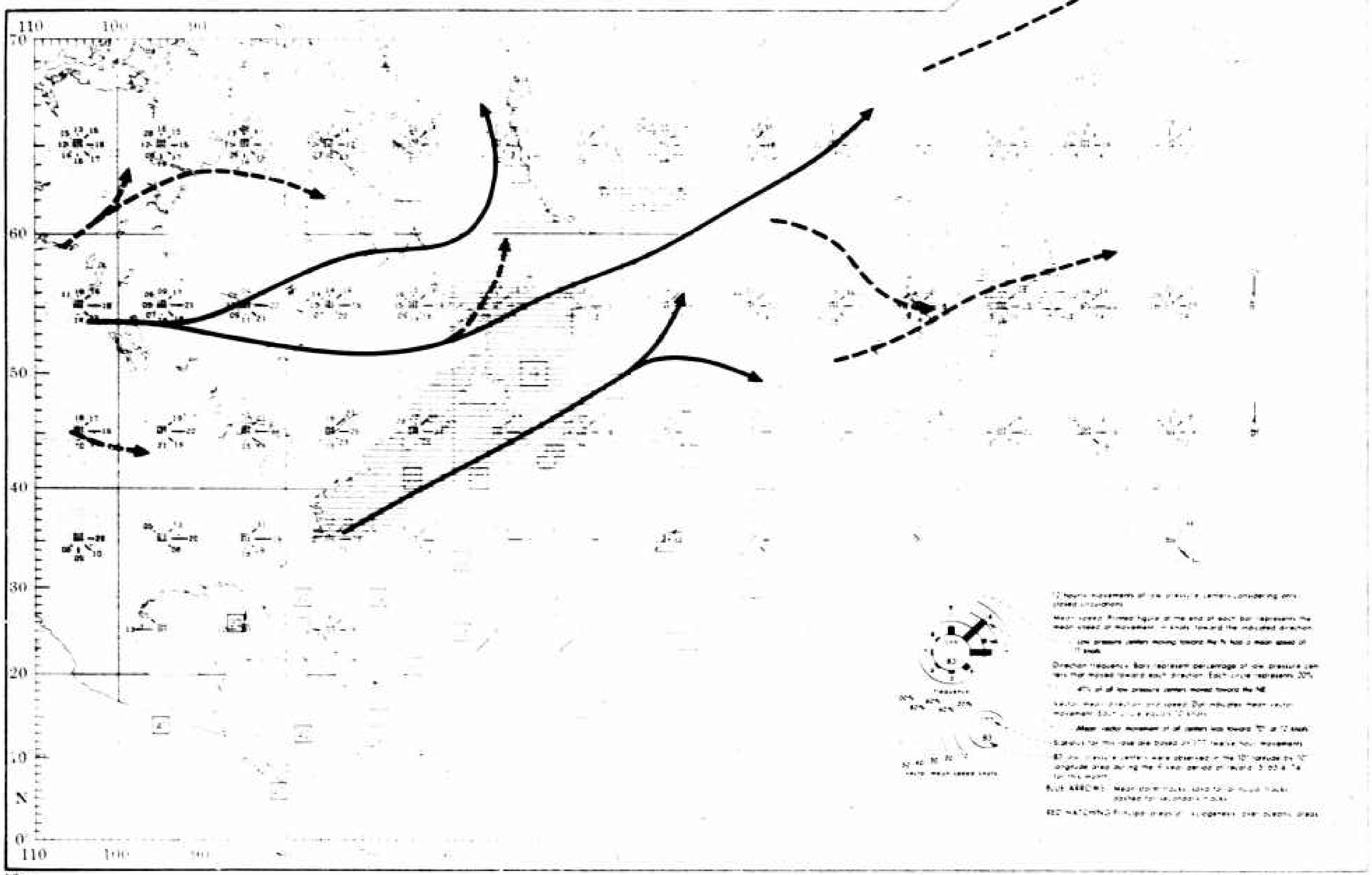
WAVE PERIOD AND HEIGHT

JULY

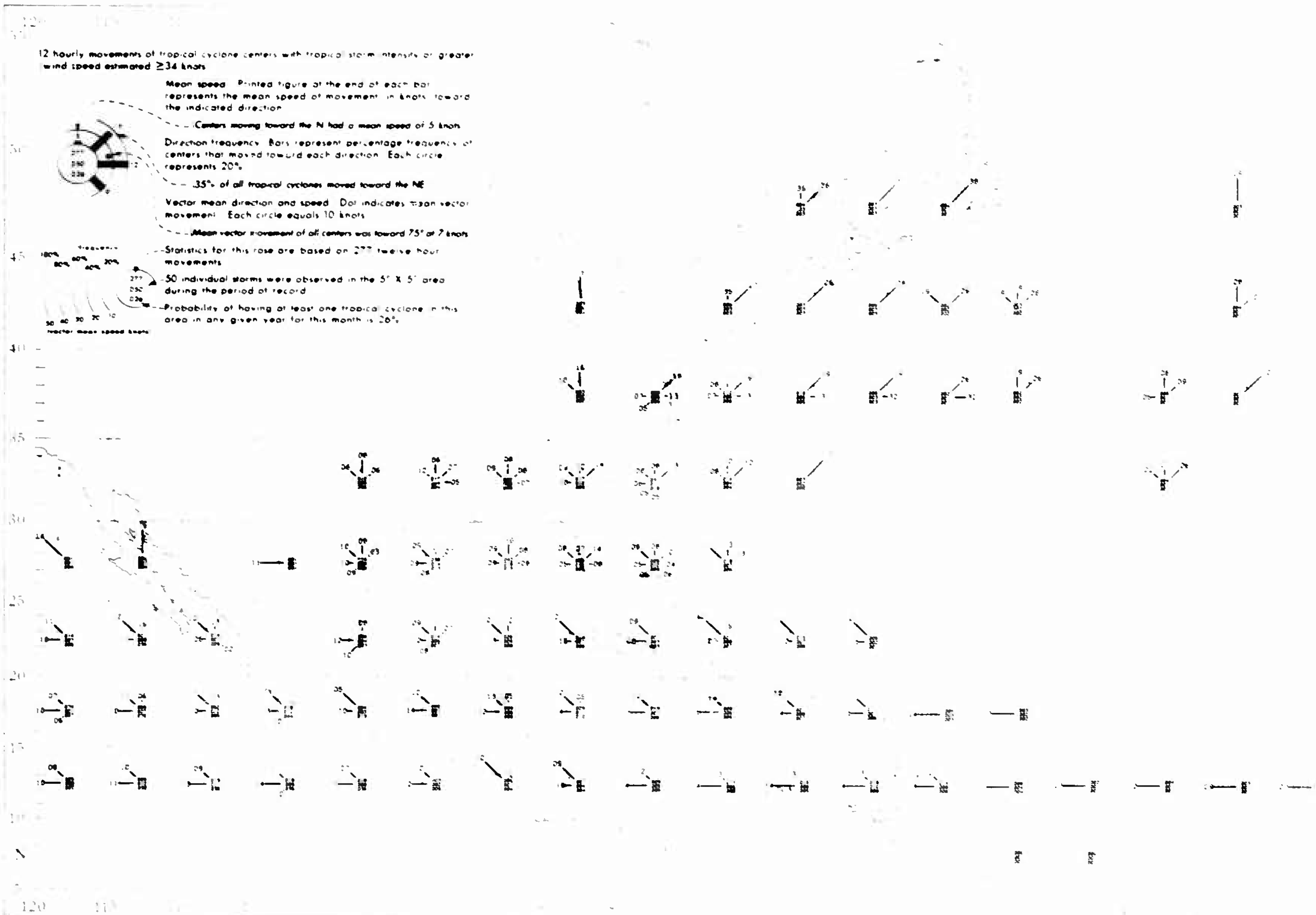


JULY

LOW PRESSURE CENTERS

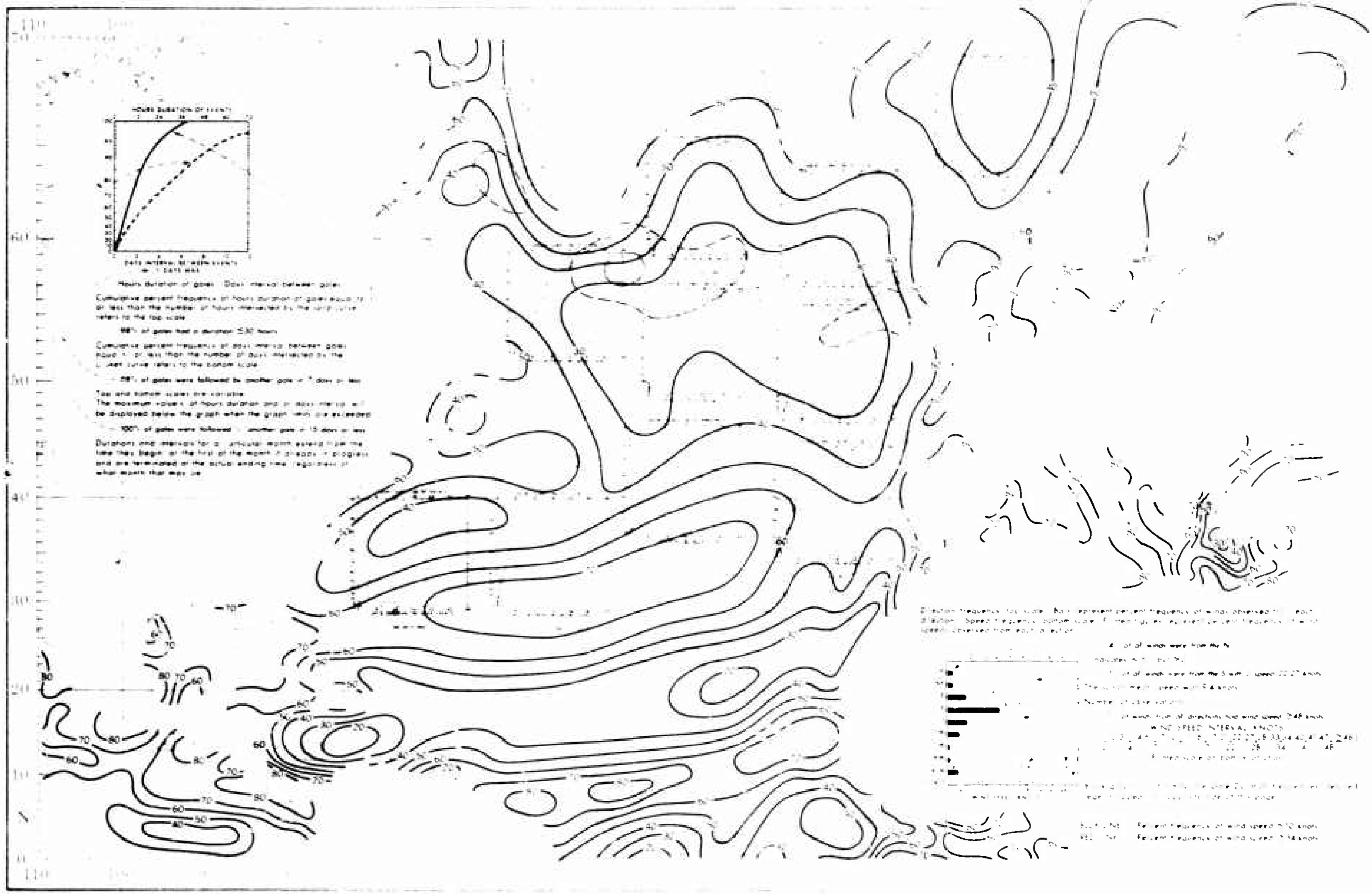


TROPICAL CYCLONE



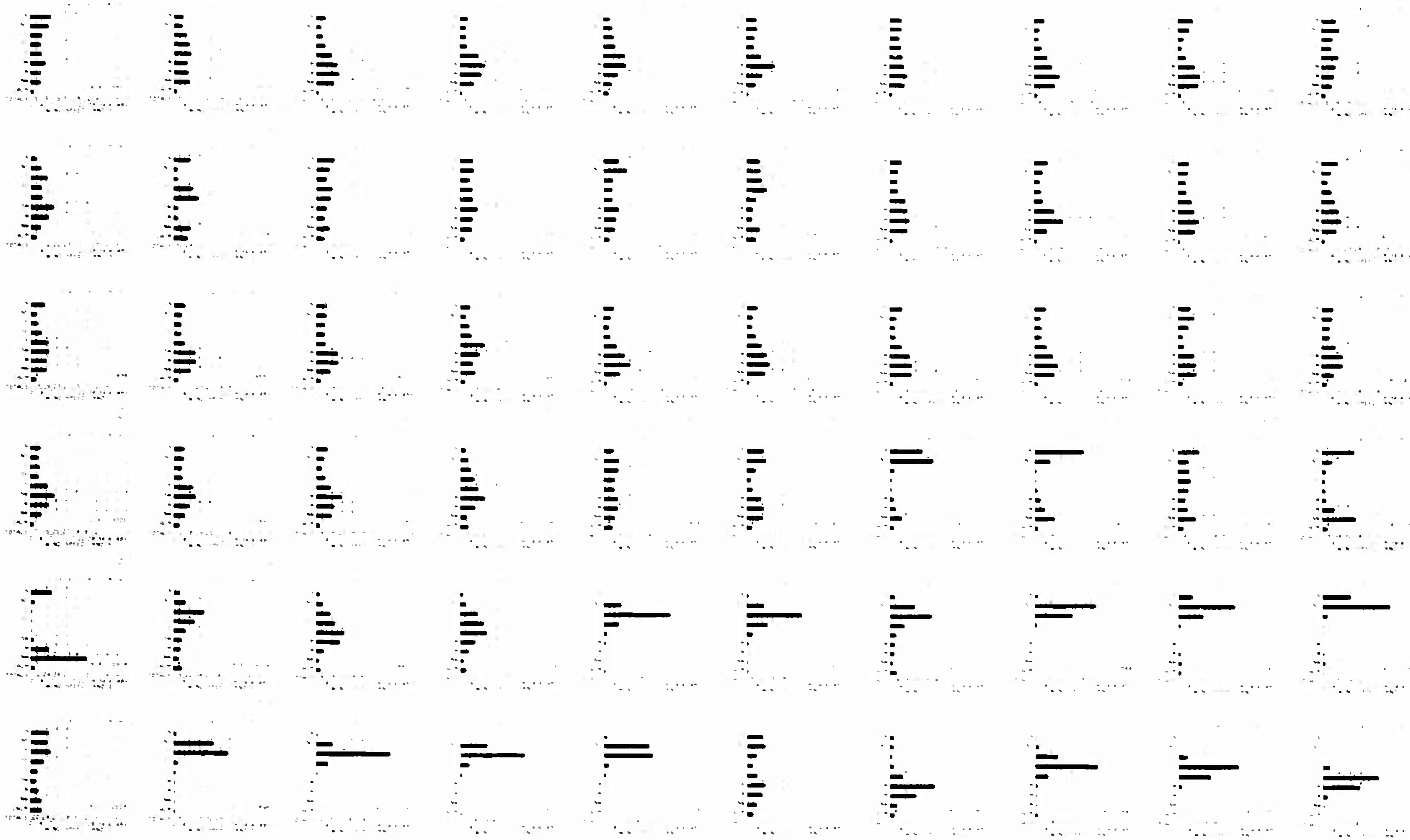
AUGUST

SURFACE WINDS

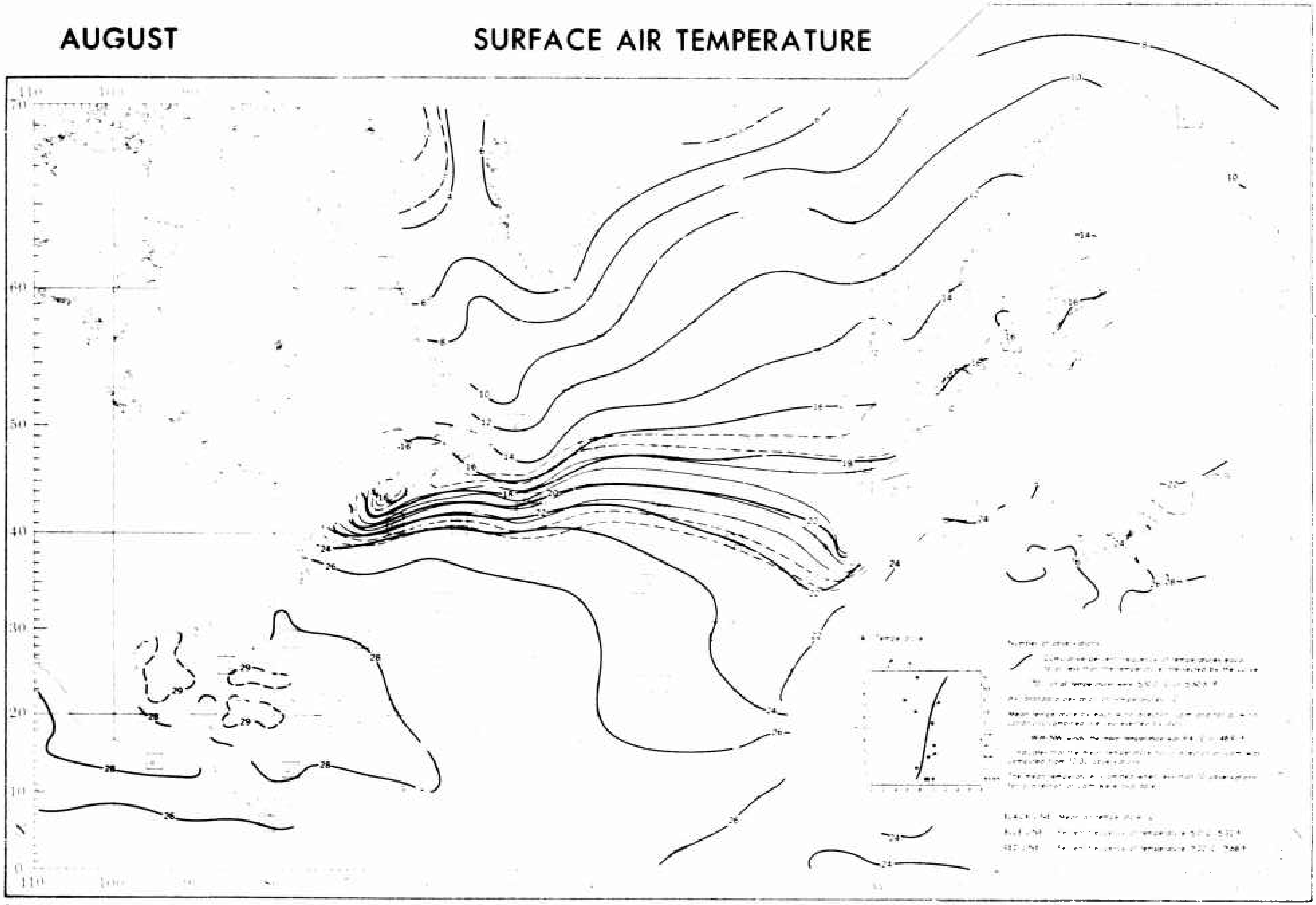


WIND DIRECTION AND SPEED

AUGUST

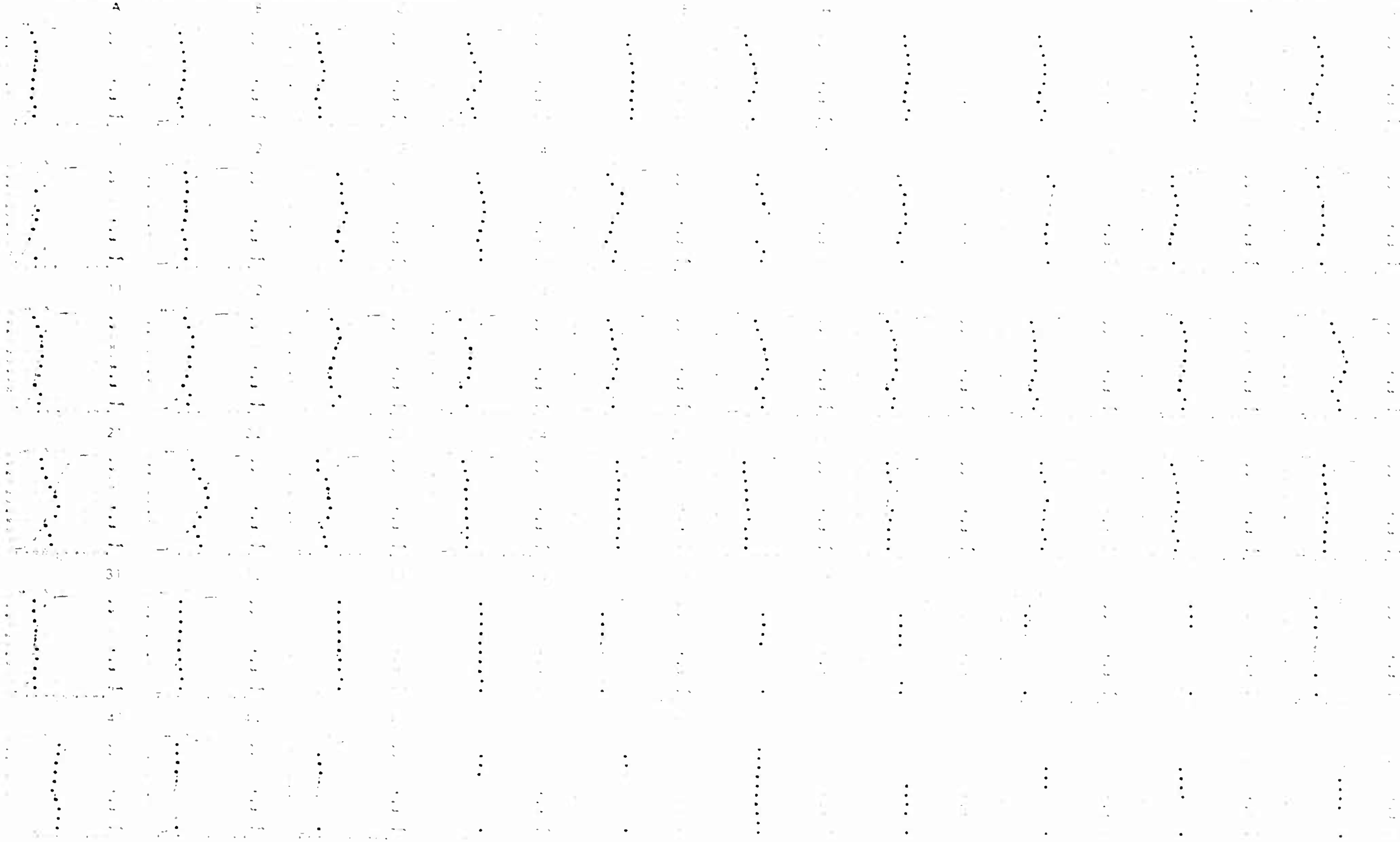


AUGUST SURFACE AIR TEMPERATURE

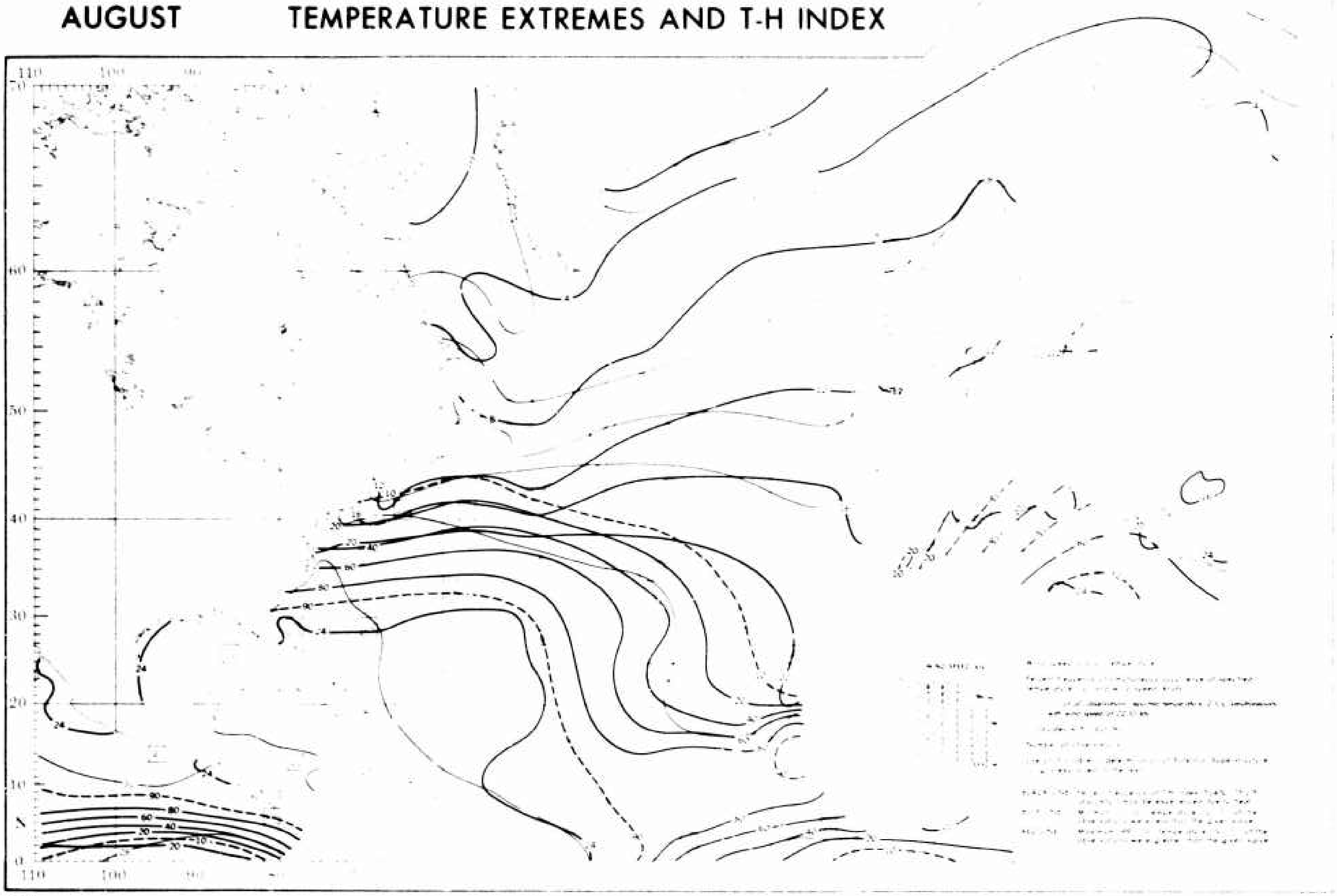


SURFACE AIR TEMPERATURE

AUGUST

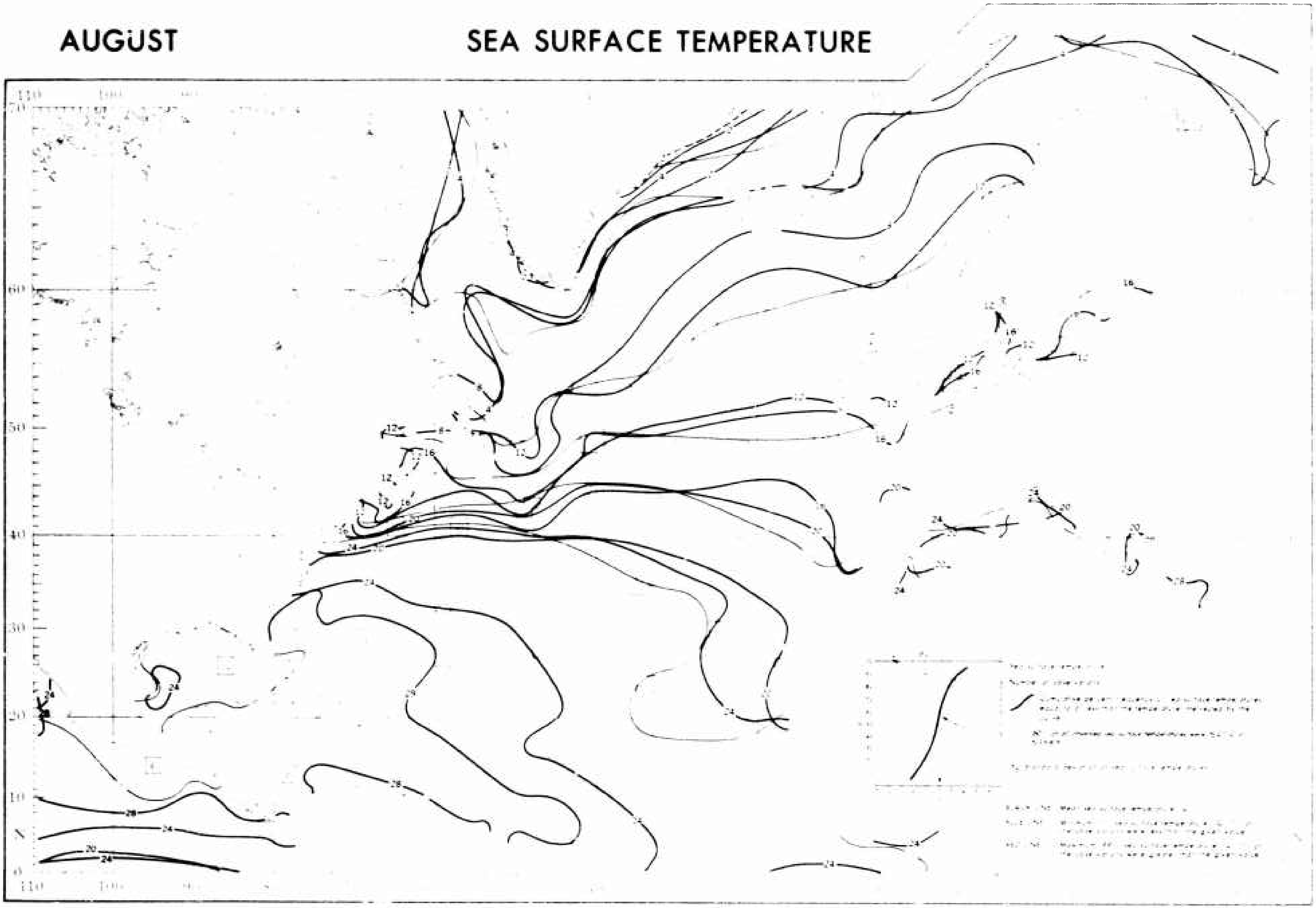


AUGUST TEMPERATURE EXTREMES AND T-H INDEX



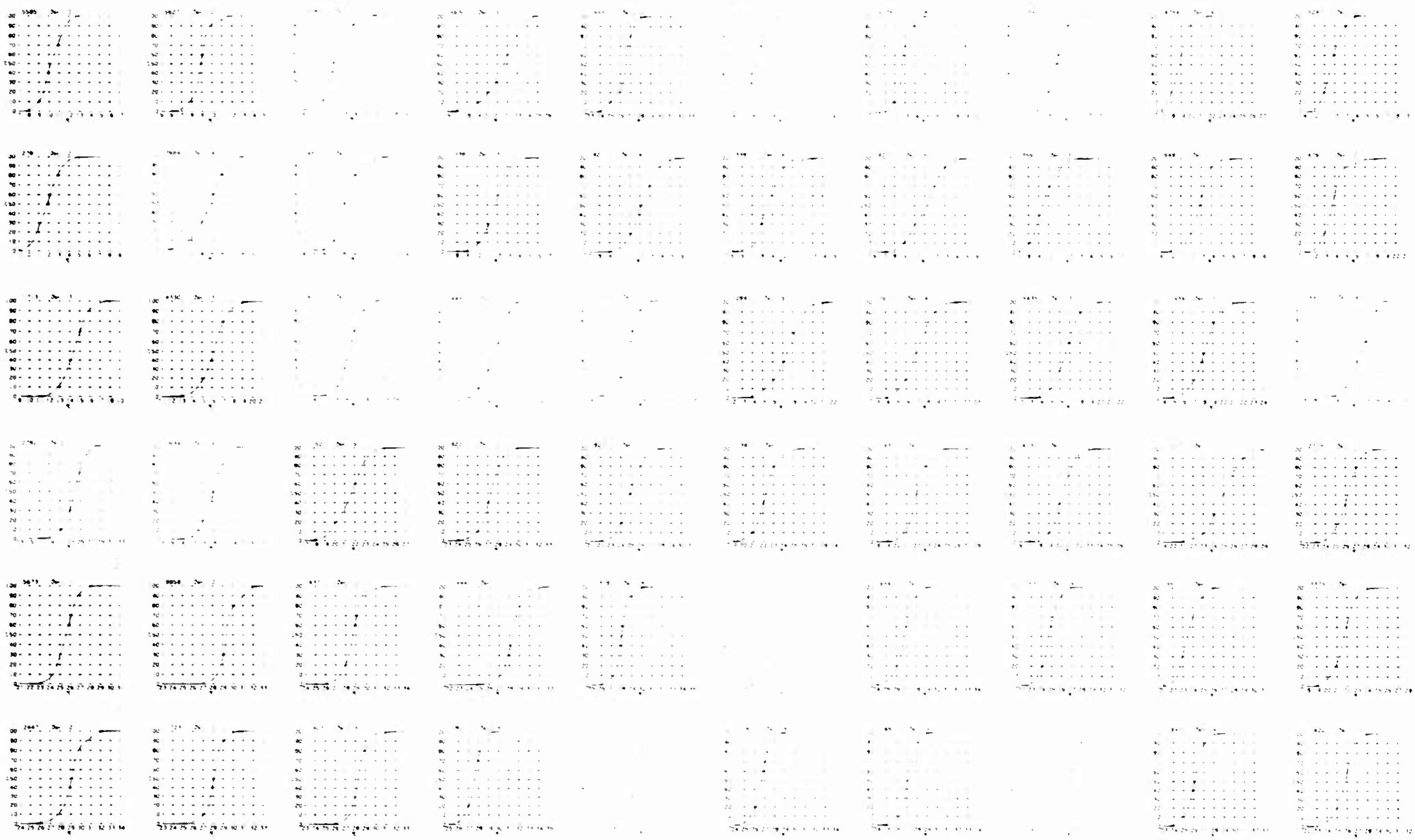
WIND SPEED AND AIR TEMPERATURE AUGUST

AUGUST SEA SURFACE TEMPERATURE

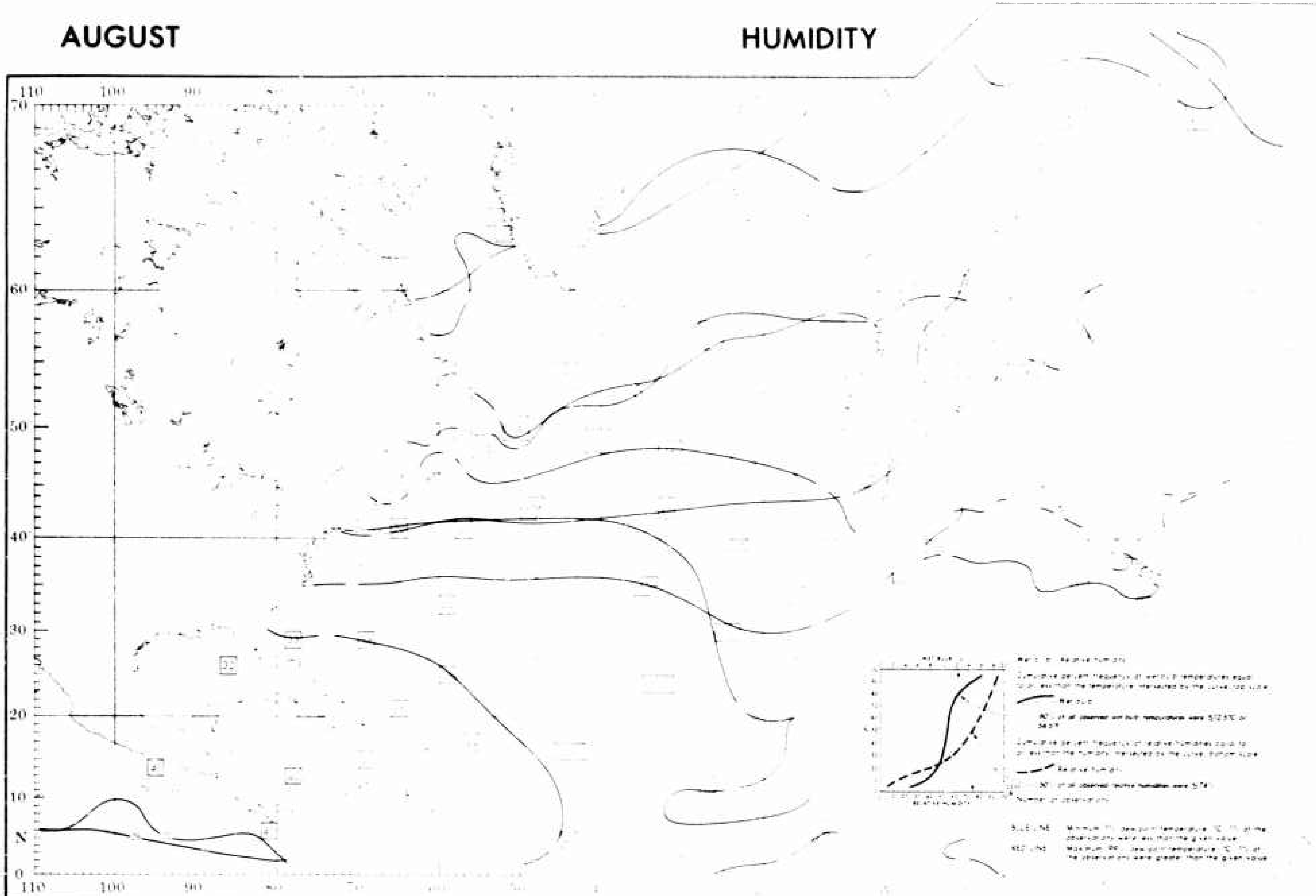


SEA SURFACE TEMPERATURE

AUGUST

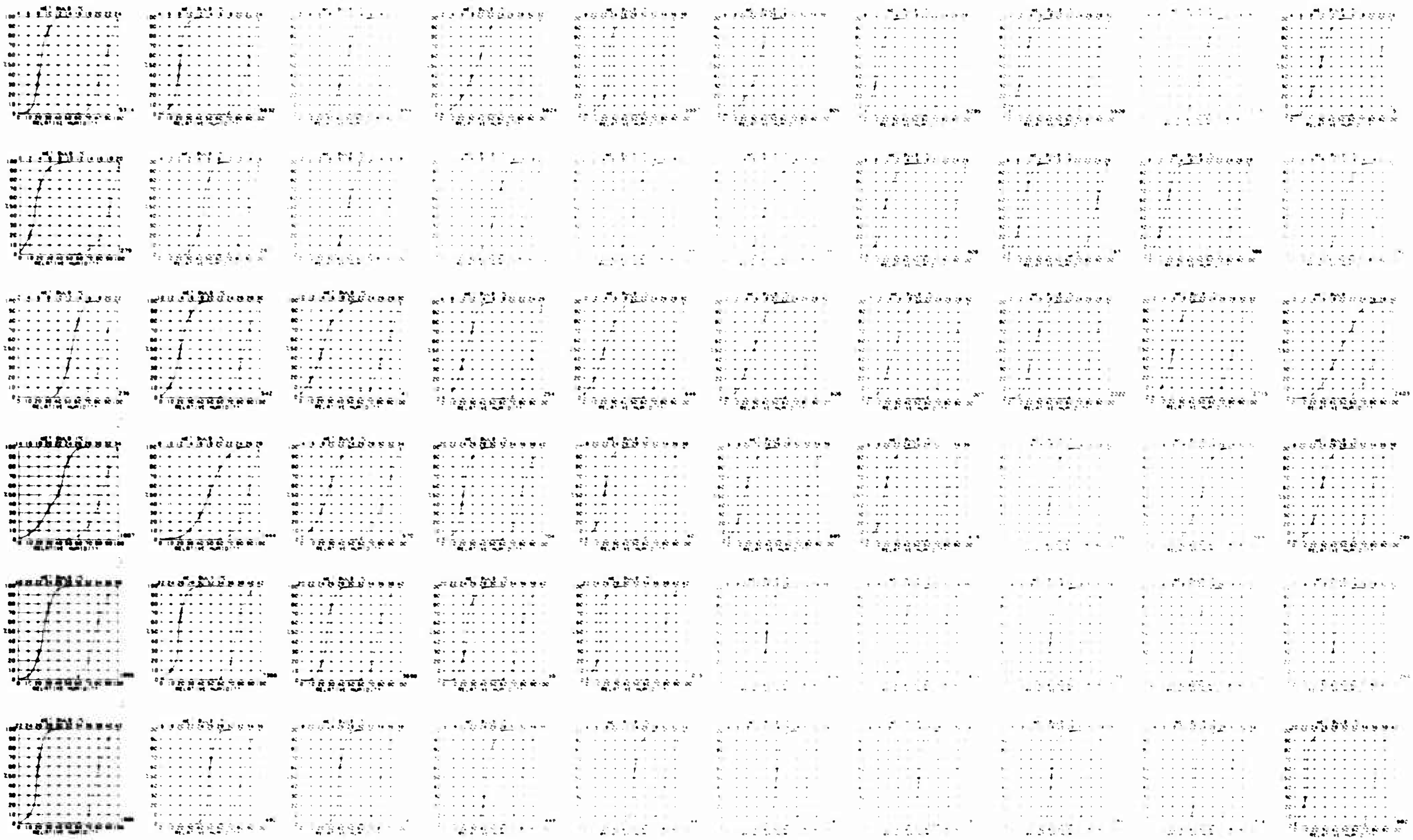


AUGUST HUMIDITY

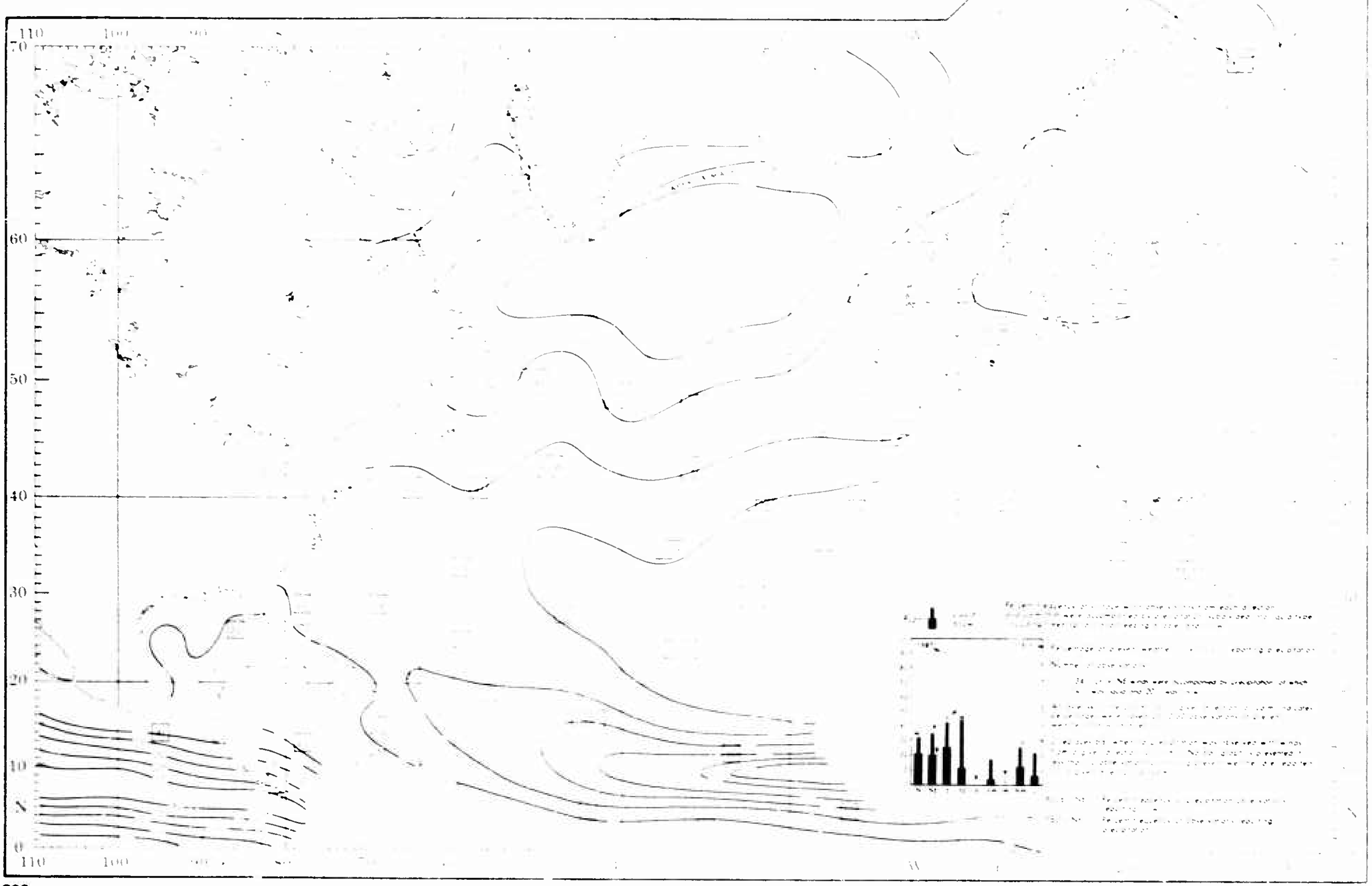


WET BULB AND RELATIVE HUMIDITY

AUGUST

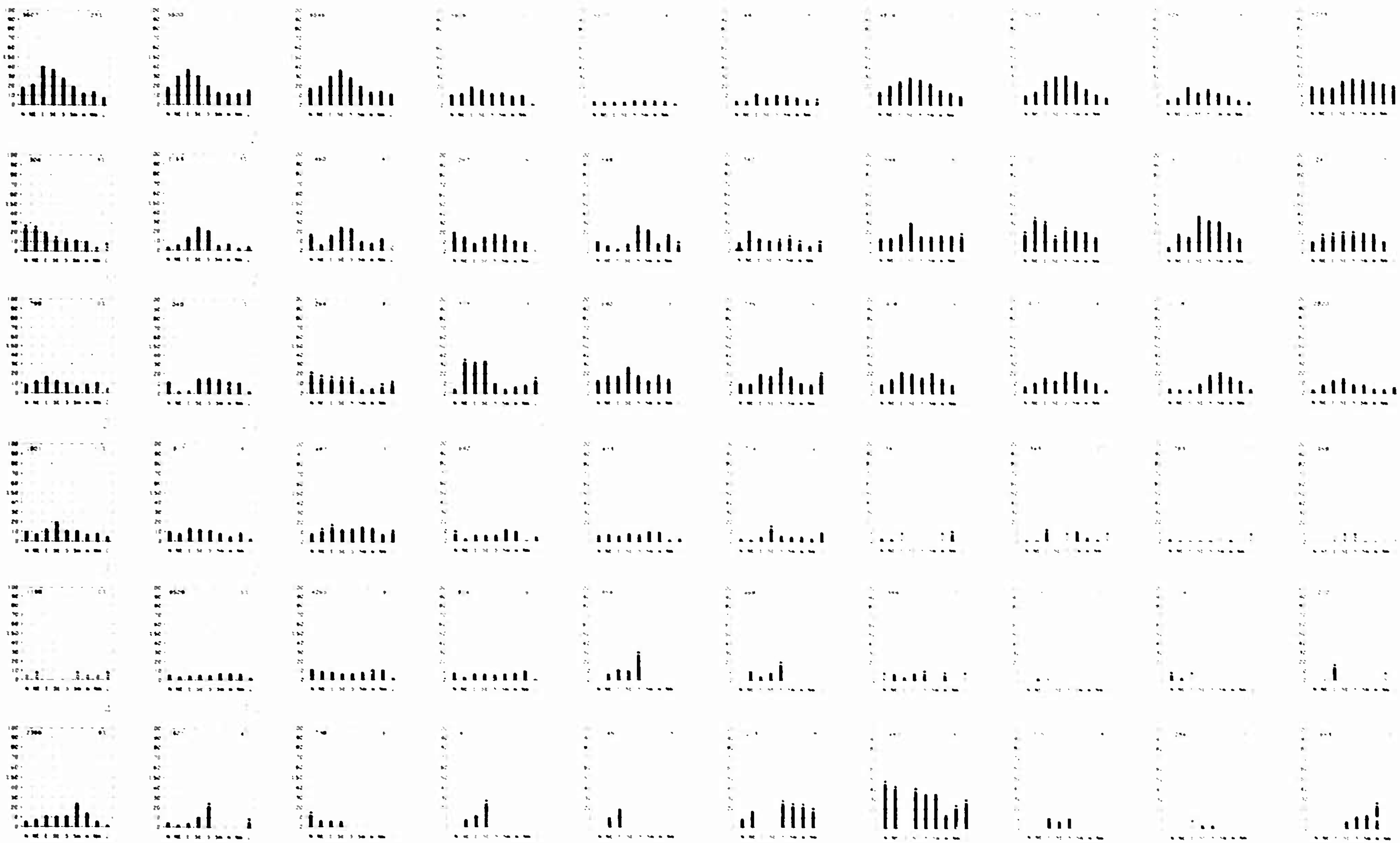


AUGUST PRECIPITATION

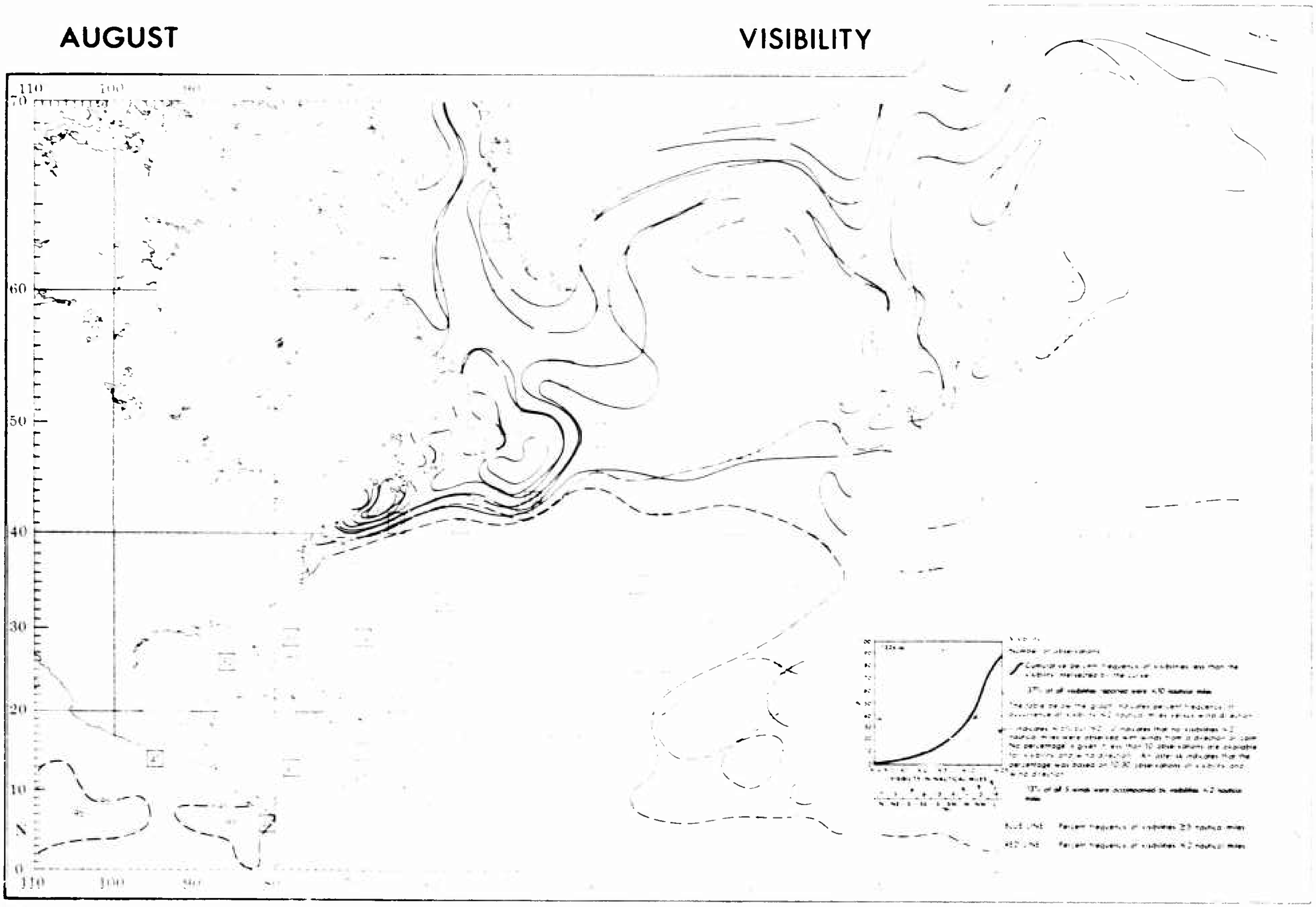


PRECIPITATION

AUGUST



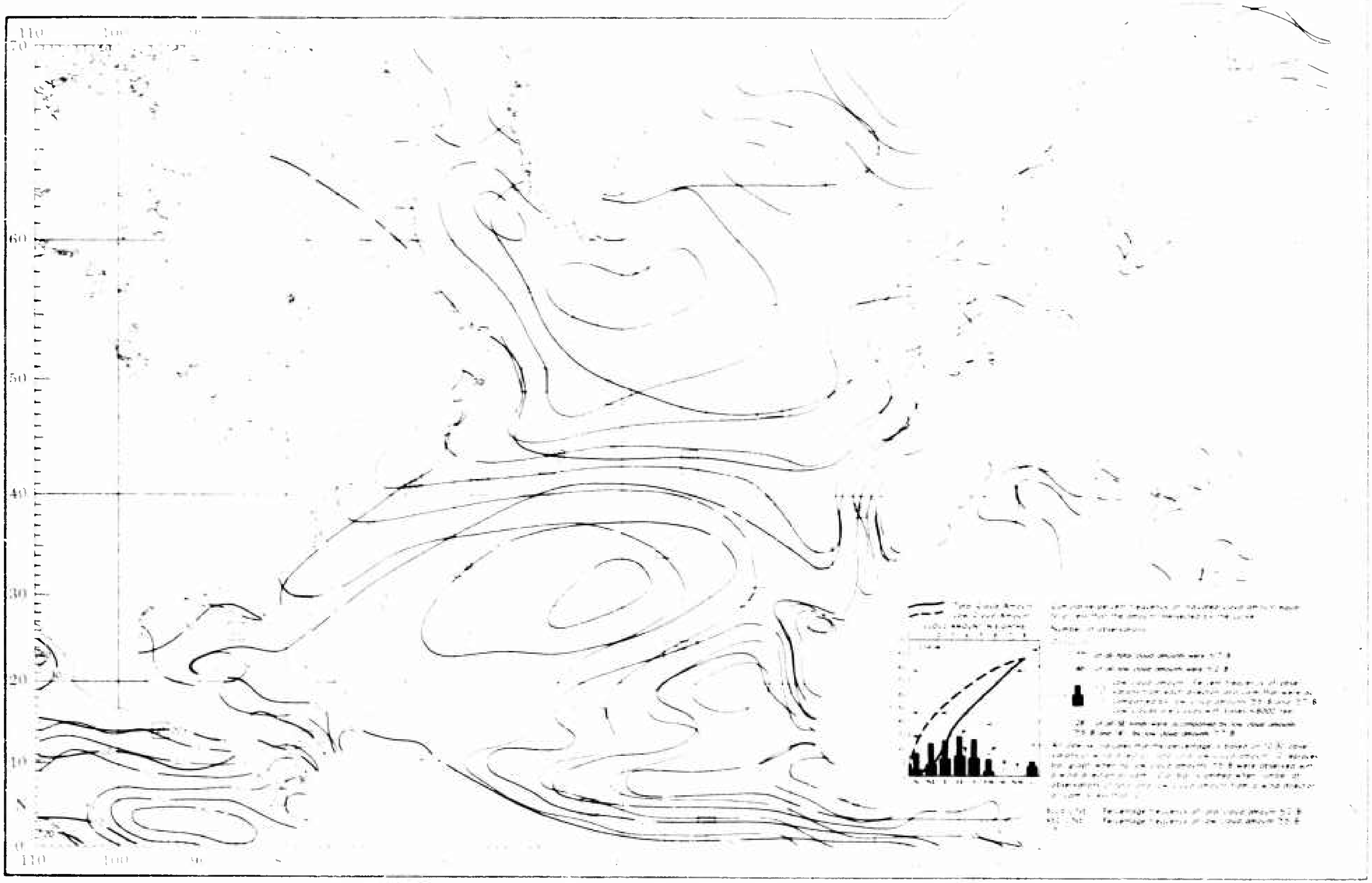
AUGUST VISIBILITY



VISIBILITY

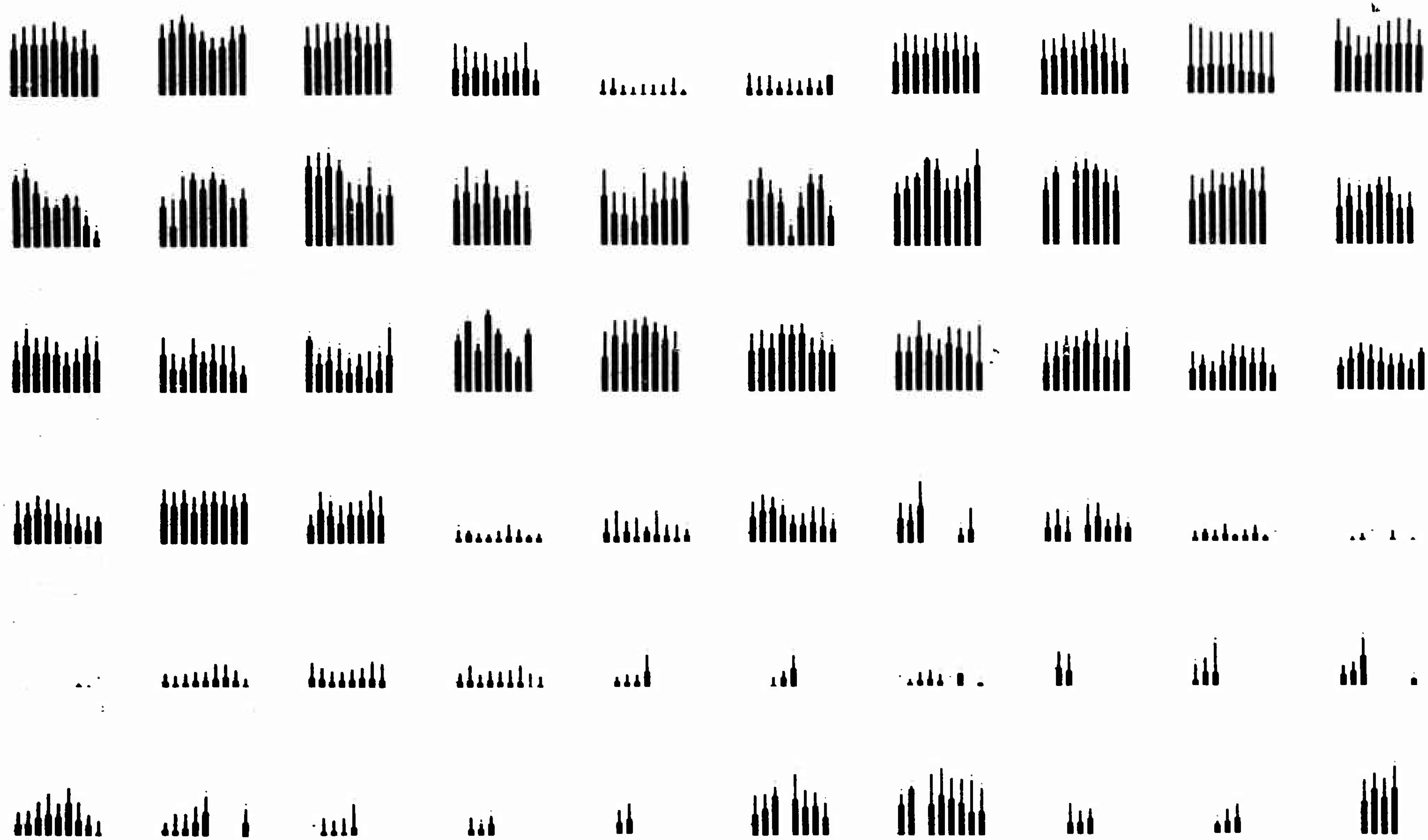
AUGUST

AUGUST CLOUD COVER

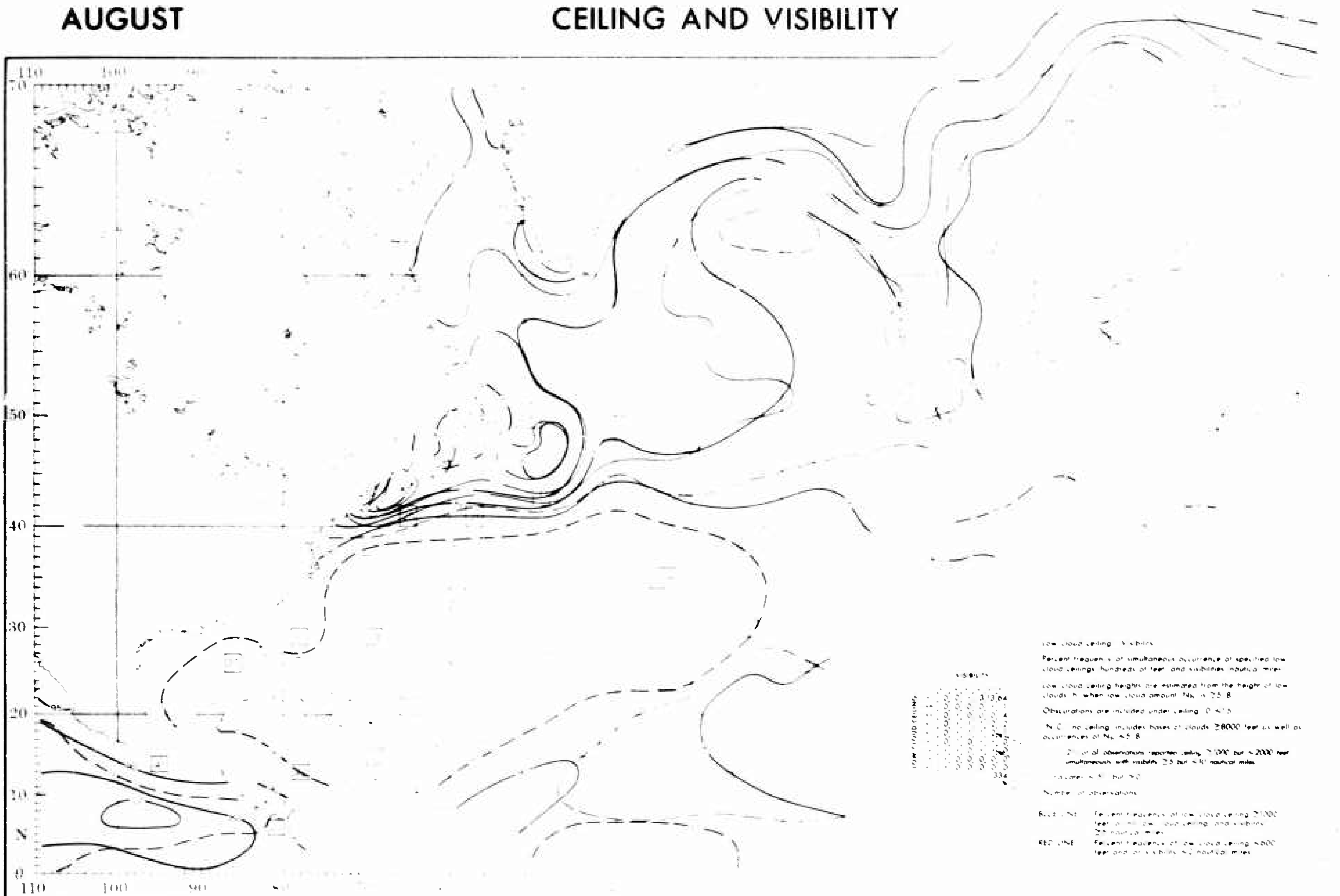


CLOUD COVER

AUGUST



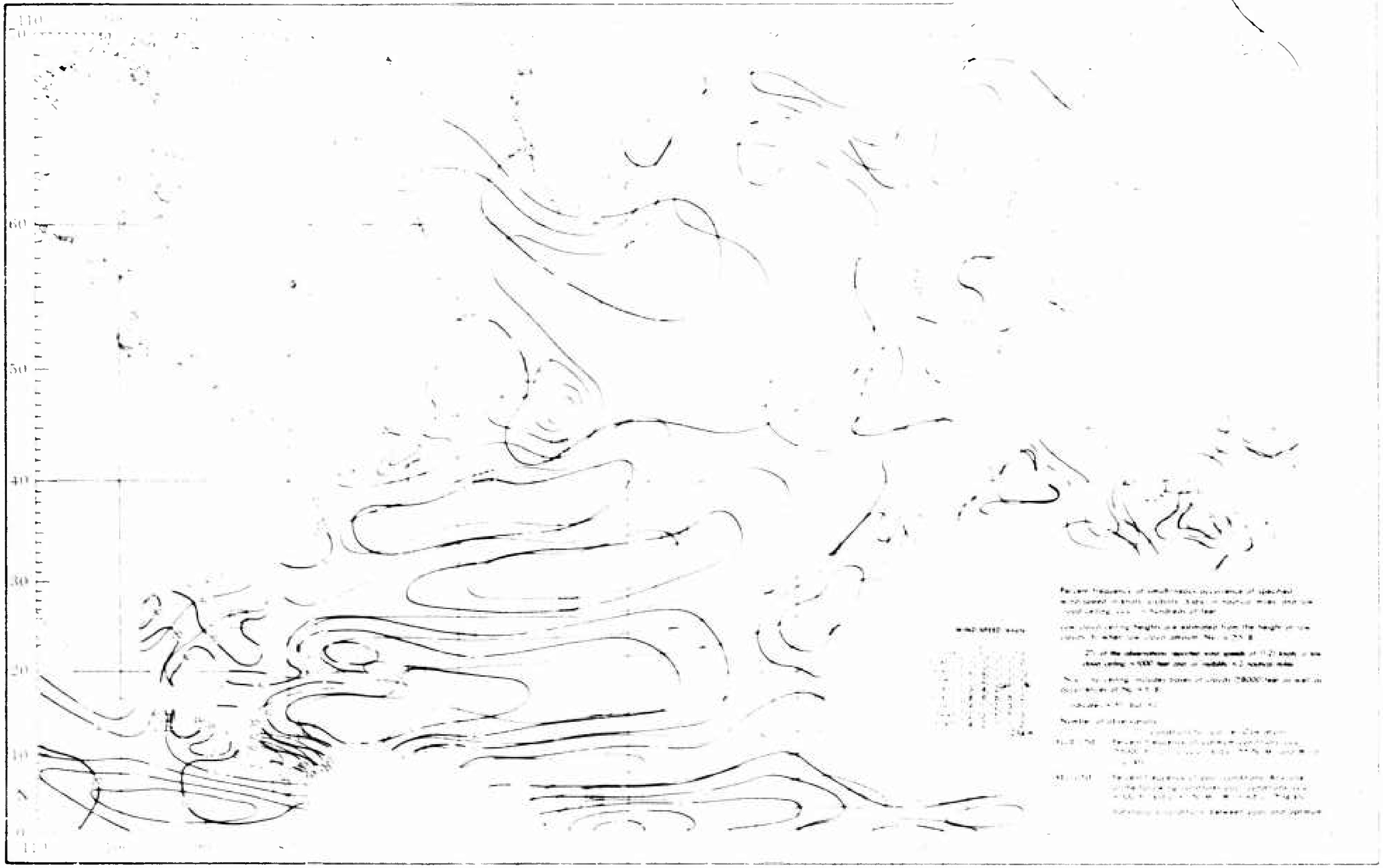
AUGUST CEILING AND VISIBILITY



CEILING AND VISIBILITY

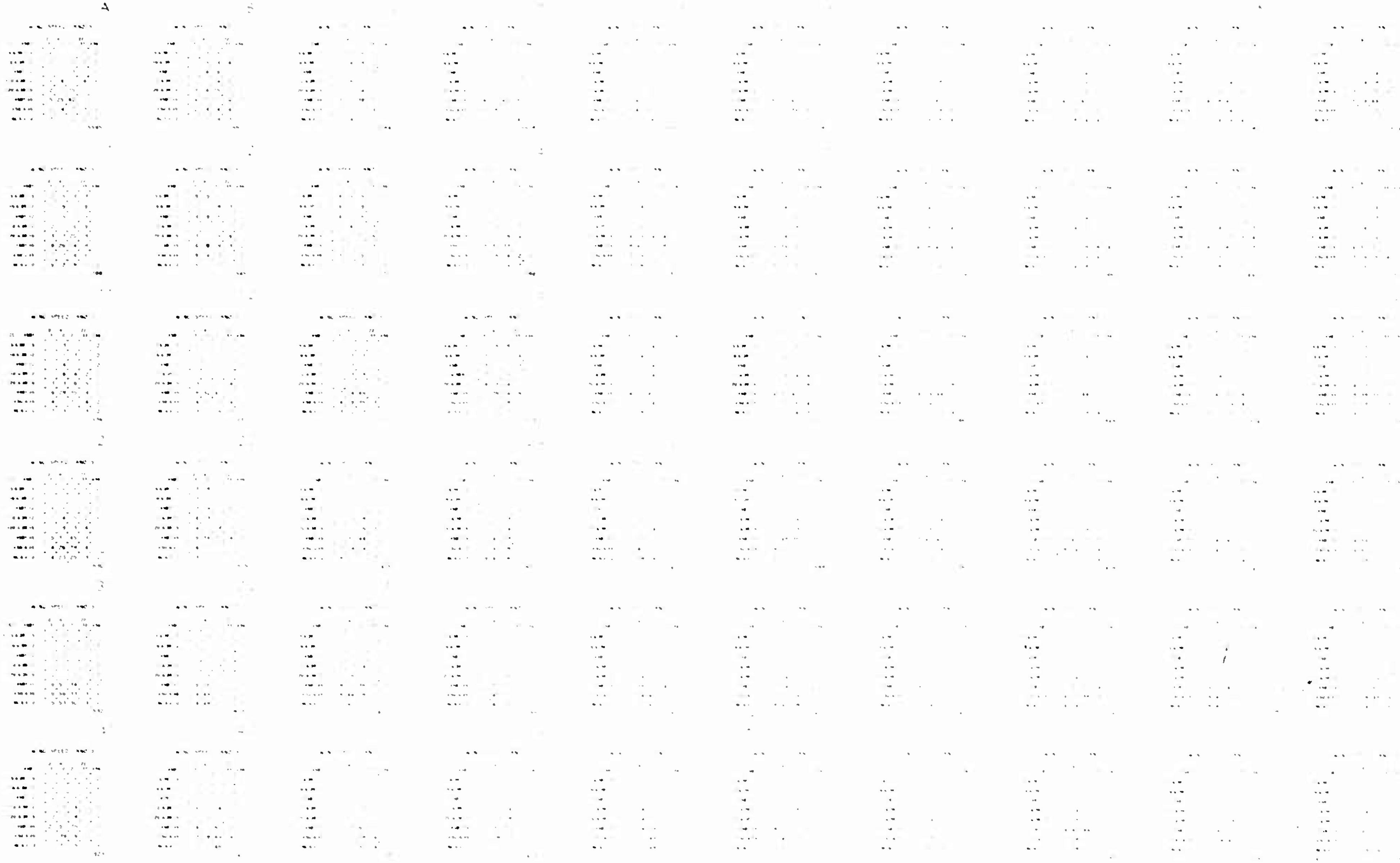
AUGUST

WIND-VISIBILITY-CLOUDINESS

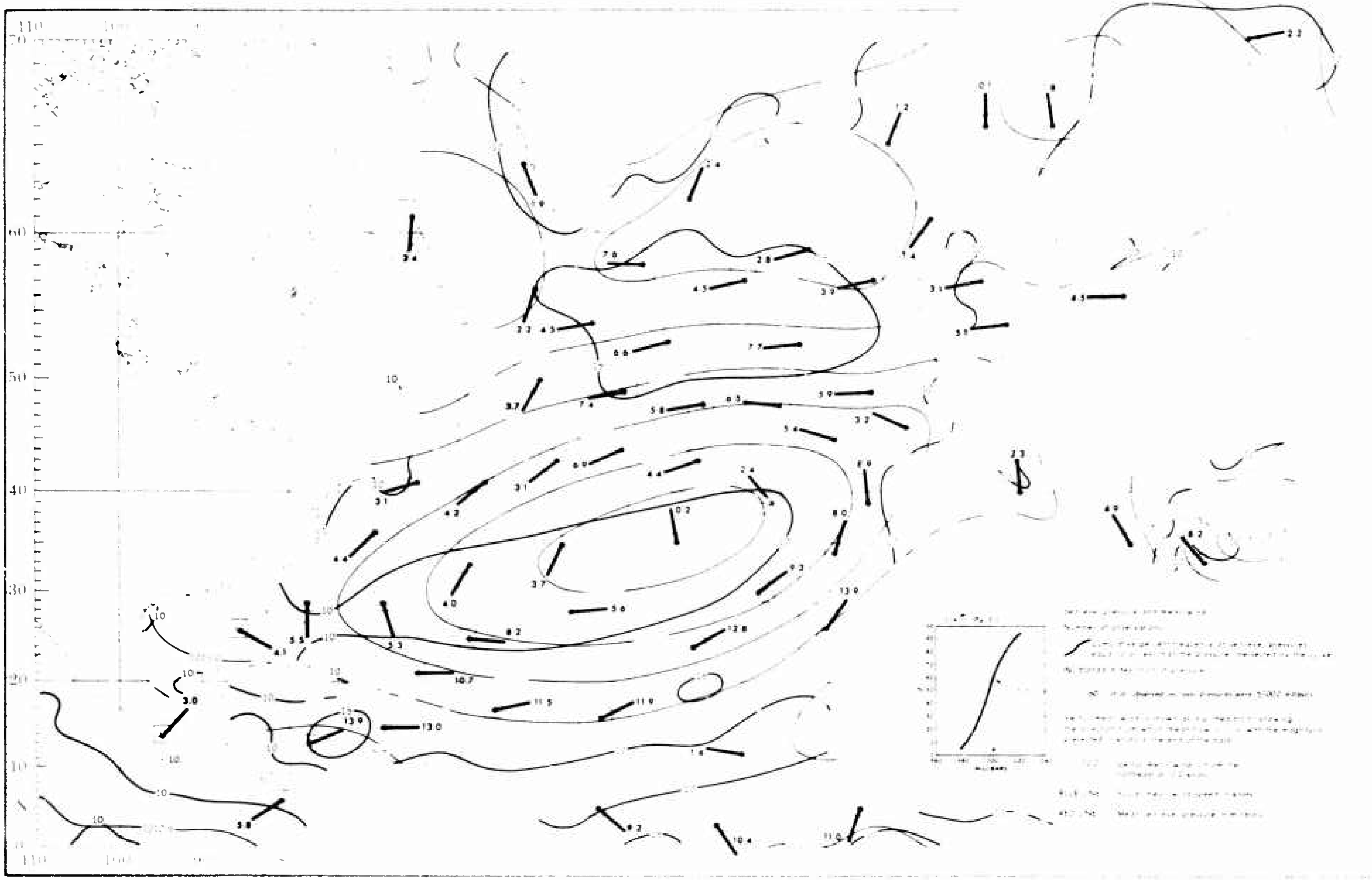


LOW CLOUD CEILING-VISIBILITY-WIND

AUGUST

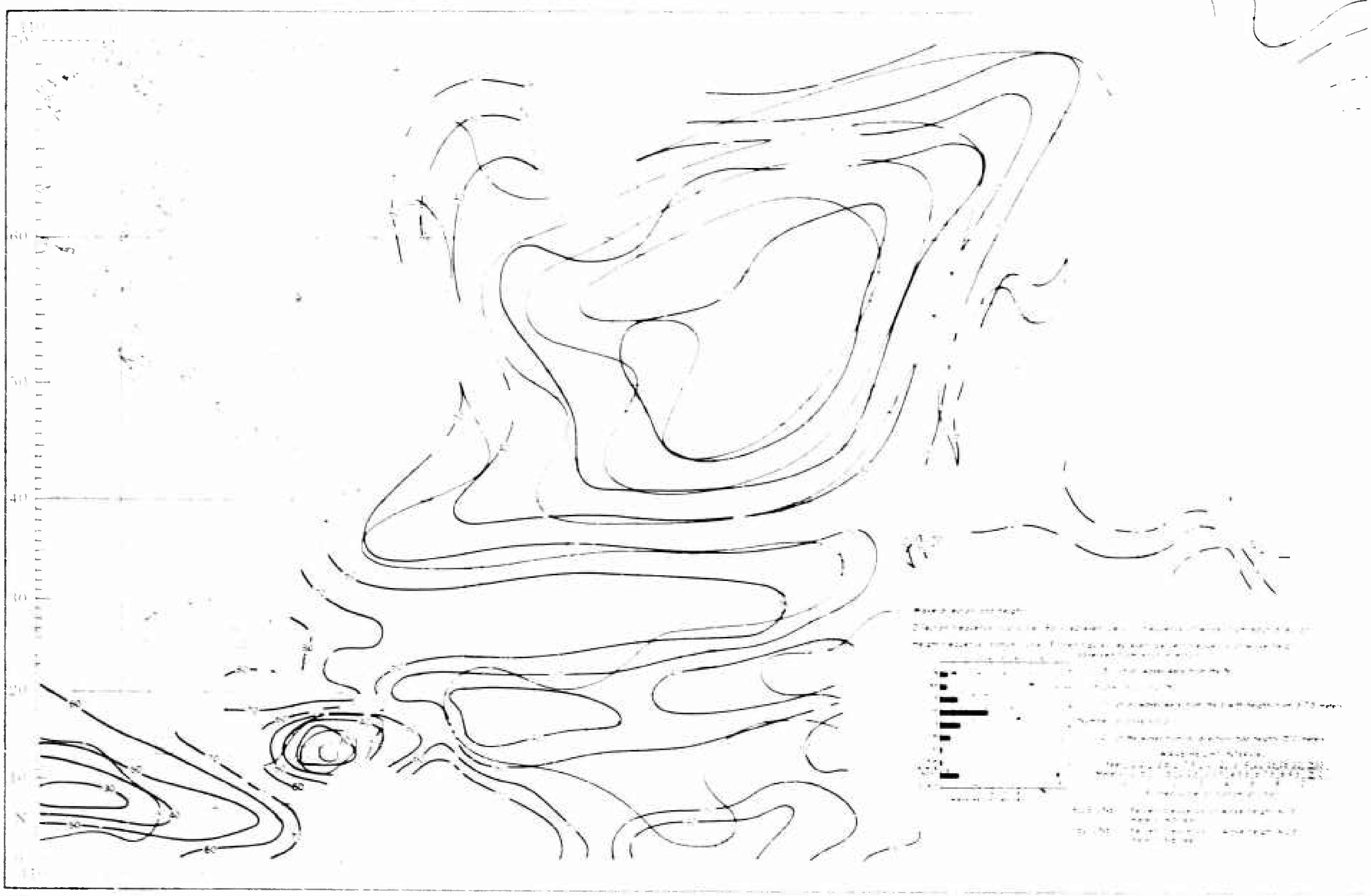


AUGUST SEA-LEVEL PRESSURE AND MEAN WIND



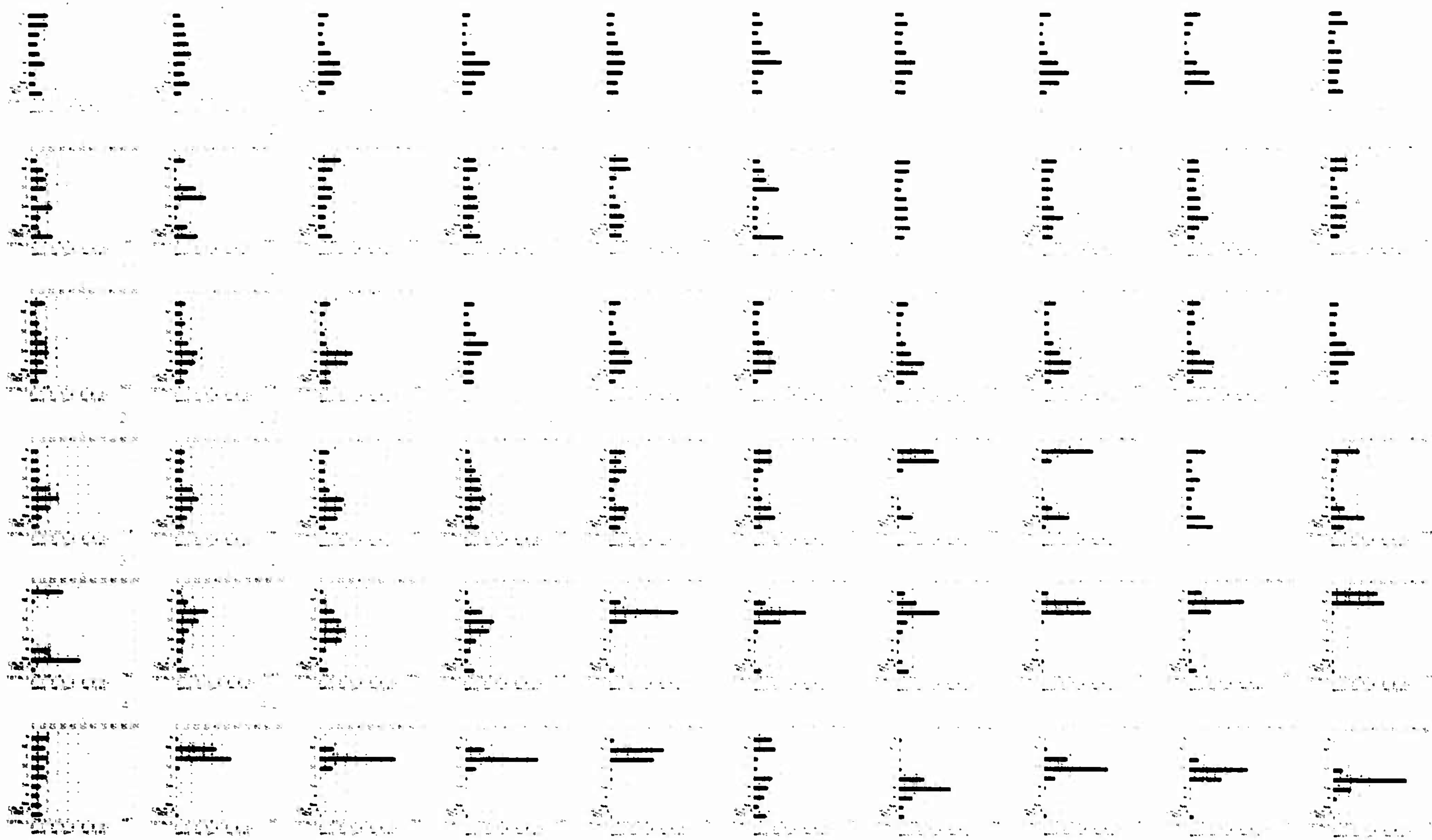
SEA LEVEL PRESSURE AUGUST

AUGUST WAVES (<1.5 AND <2.5 METERS)

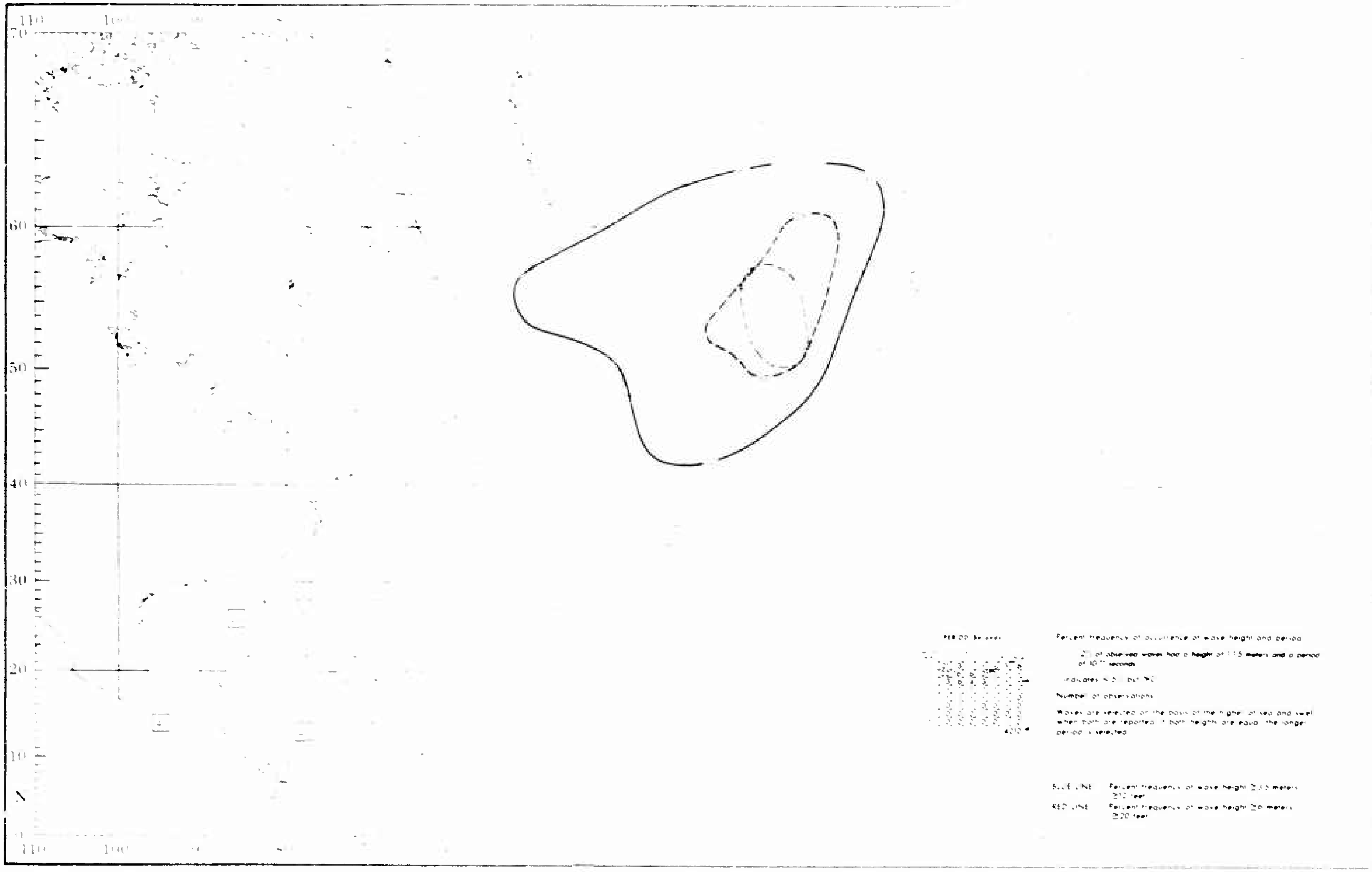


WAVE DIRECTION AND HEIGHT

AUGUST

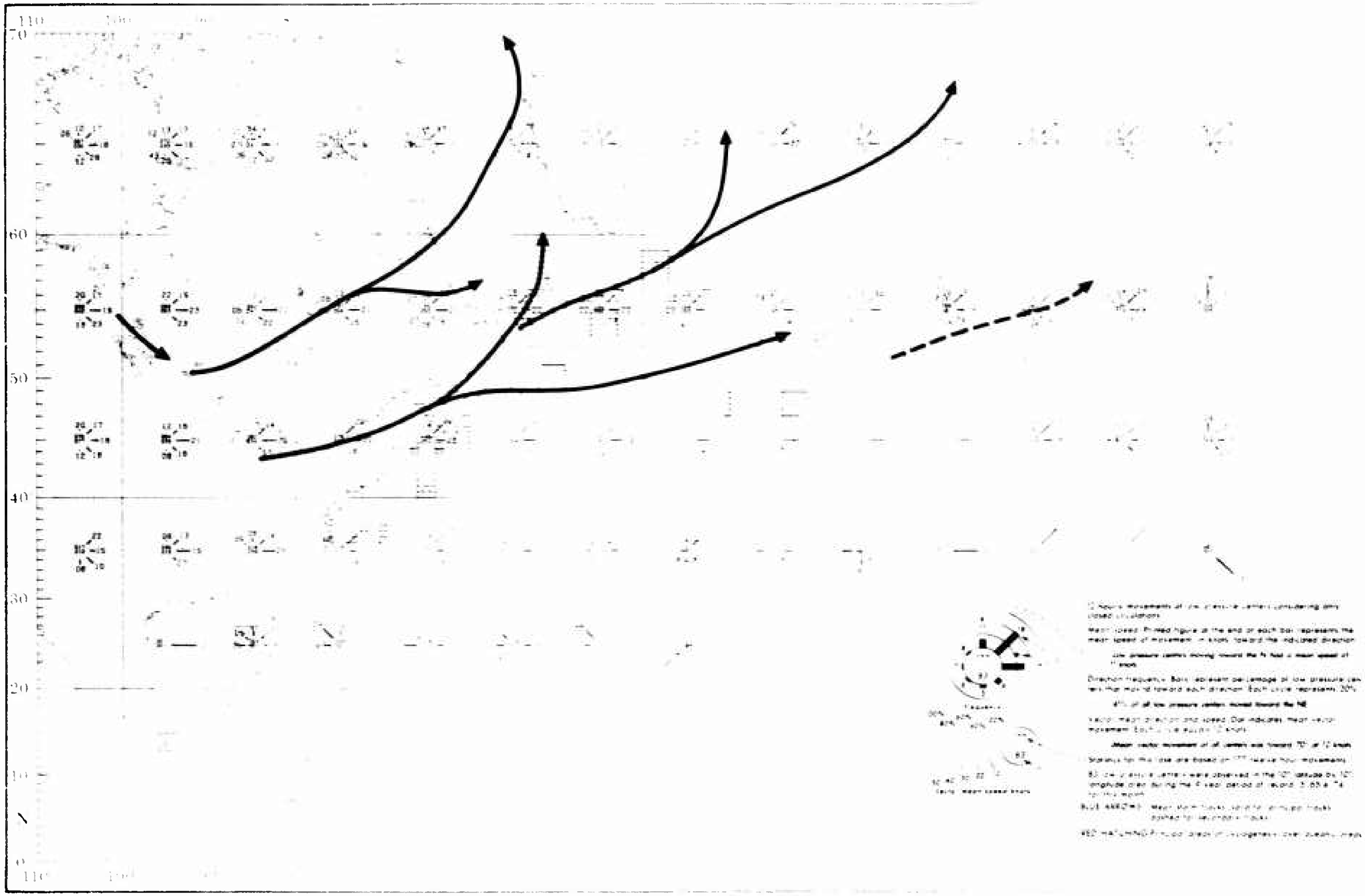


AUGUST   WAVES (≥3.5 AND ≥6 METERS)



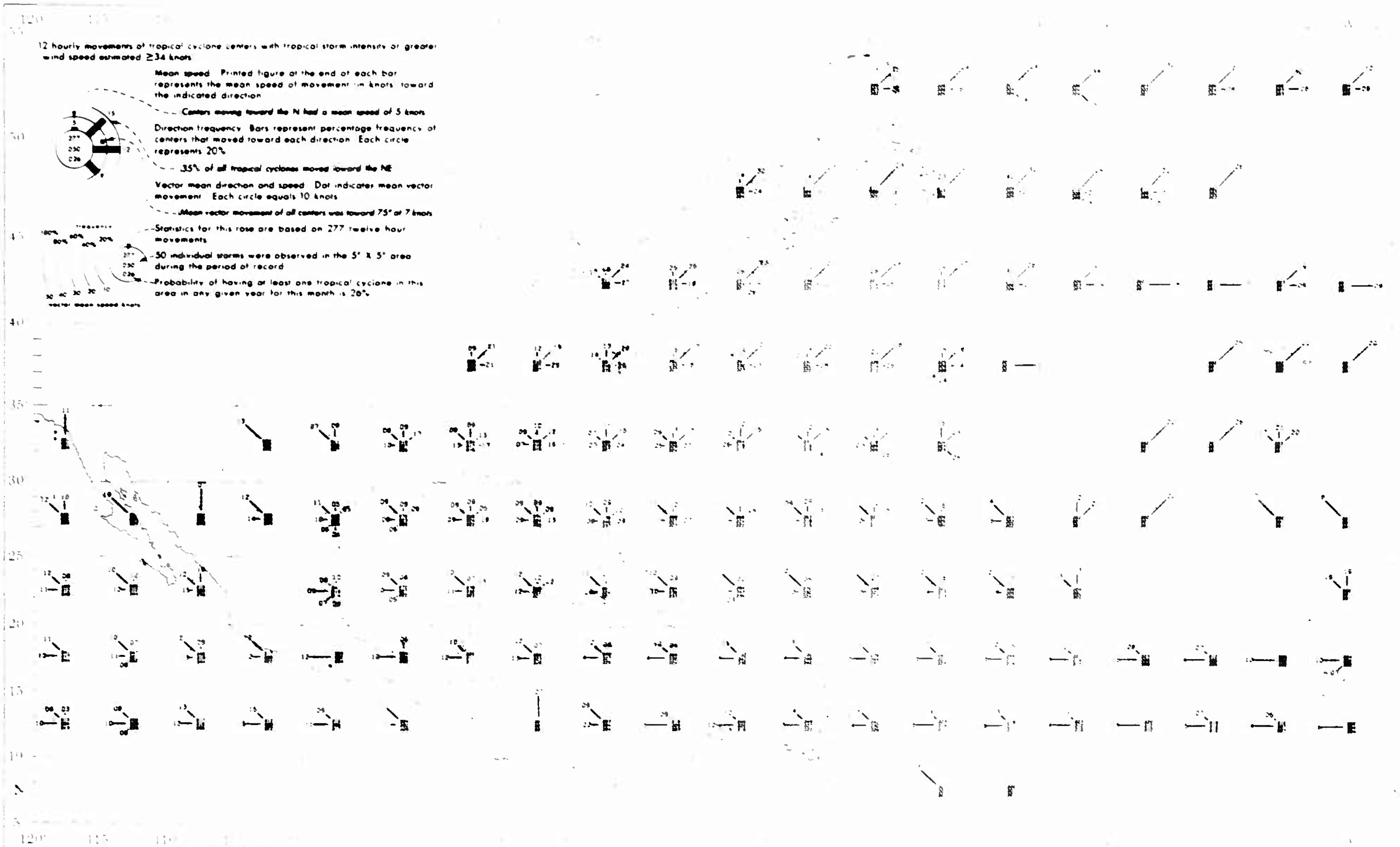
AUGUST

LOW PRESSURE CENTERS

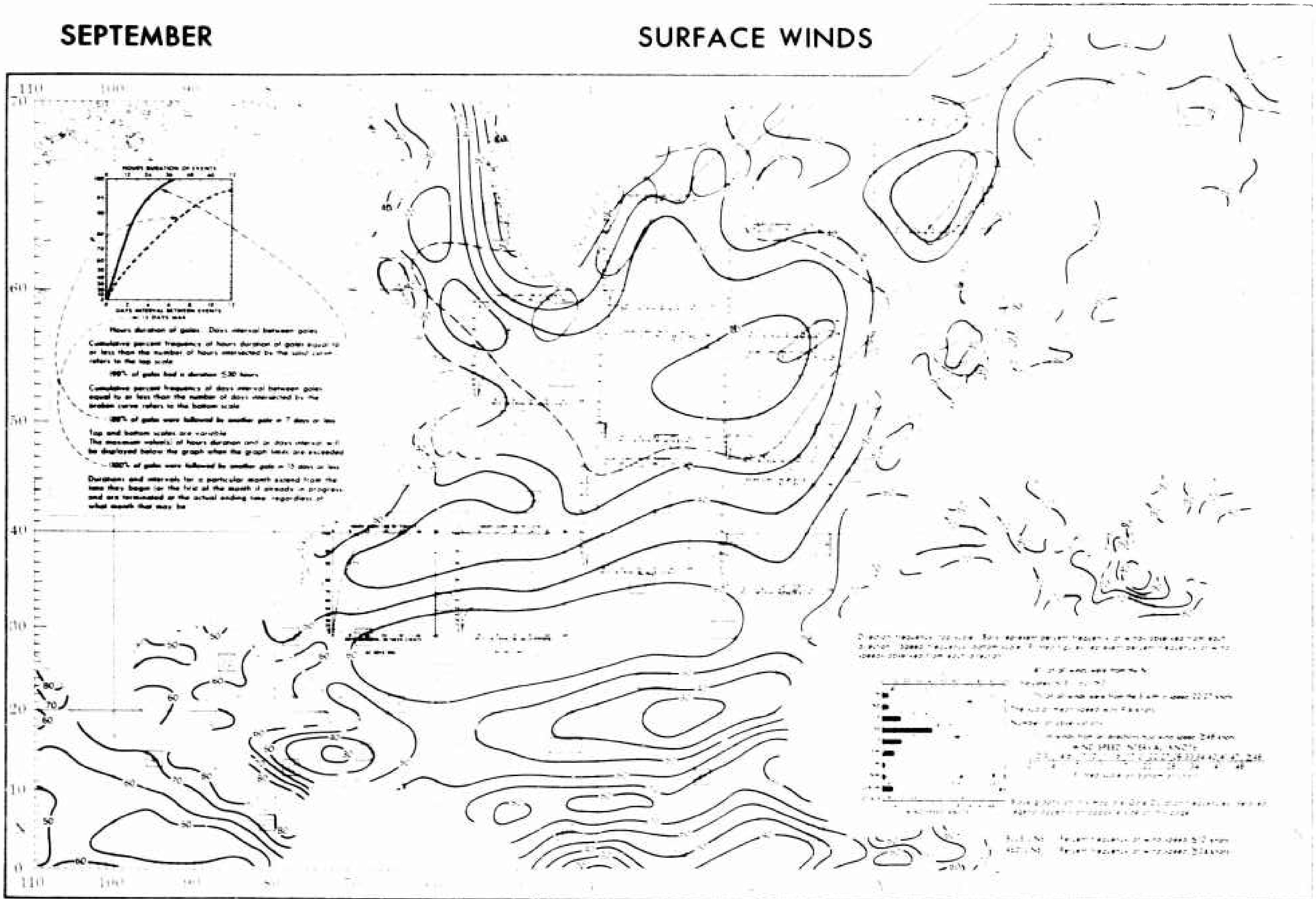


TROPICAL CYCLONE

AUGUST

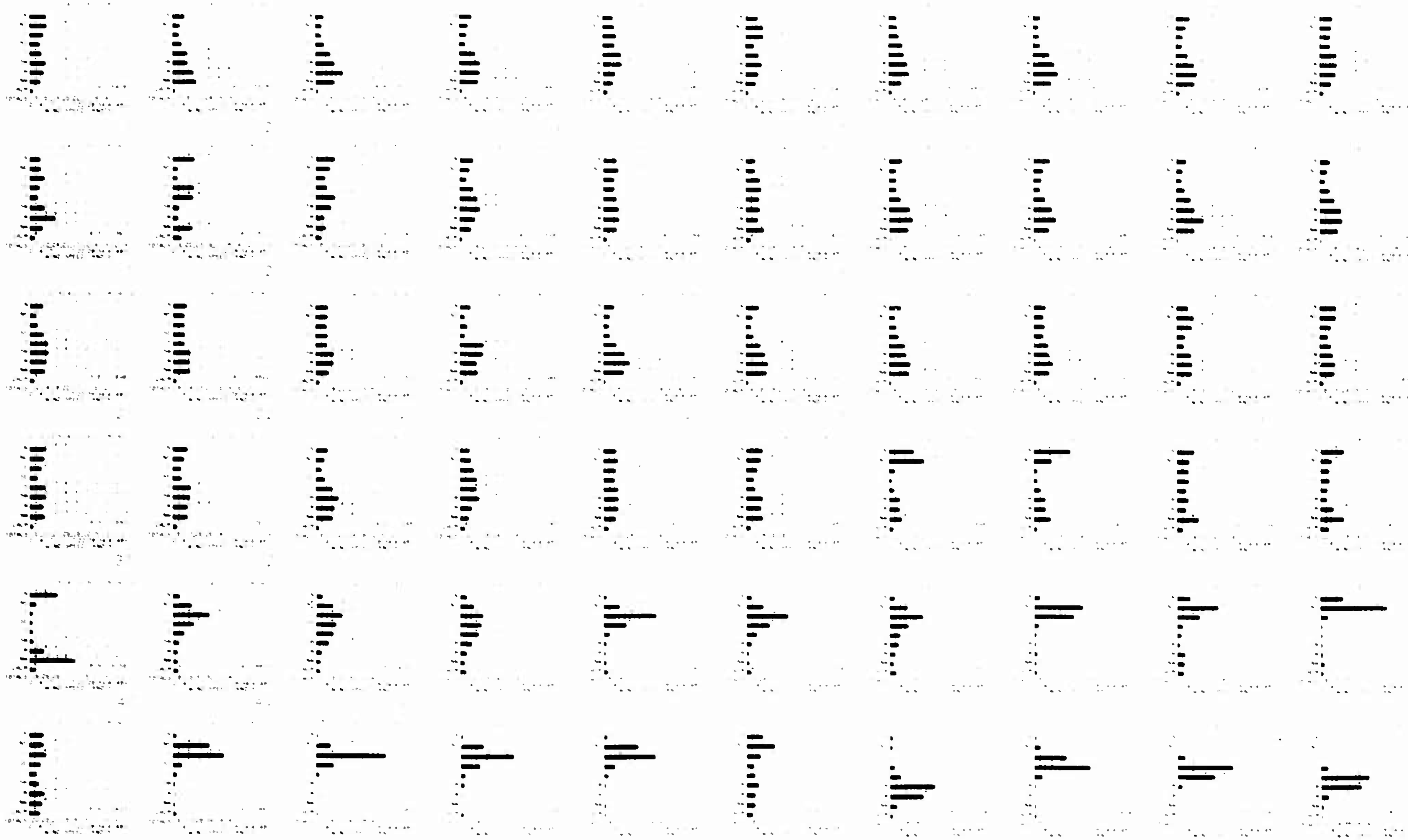


SEPTEMBER SURFACE WINDS

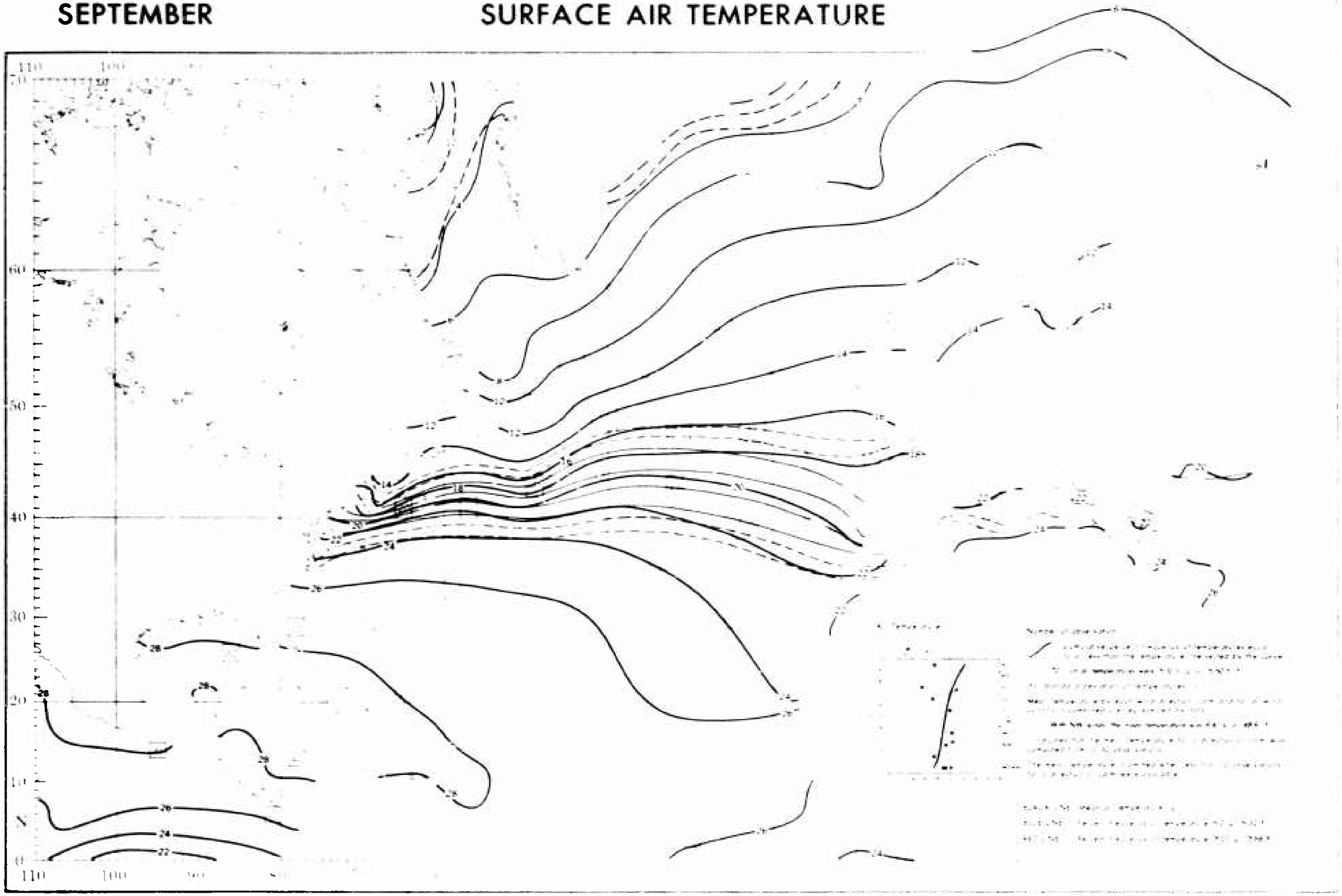


WIND DIRECTION AND SPEED

SEPTEMBER

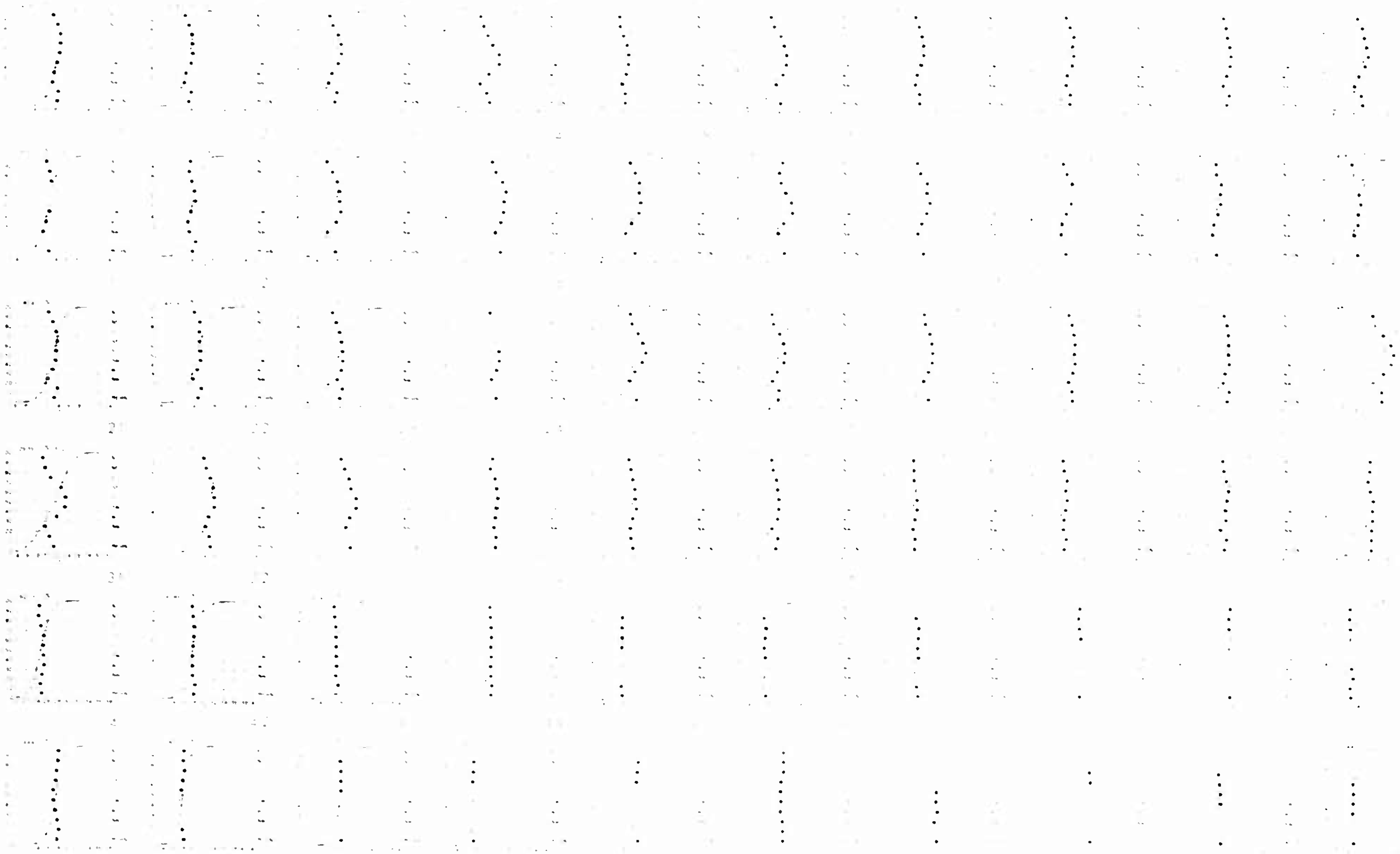


SEPTEMBER SURFACE AIR TEMPERATURE

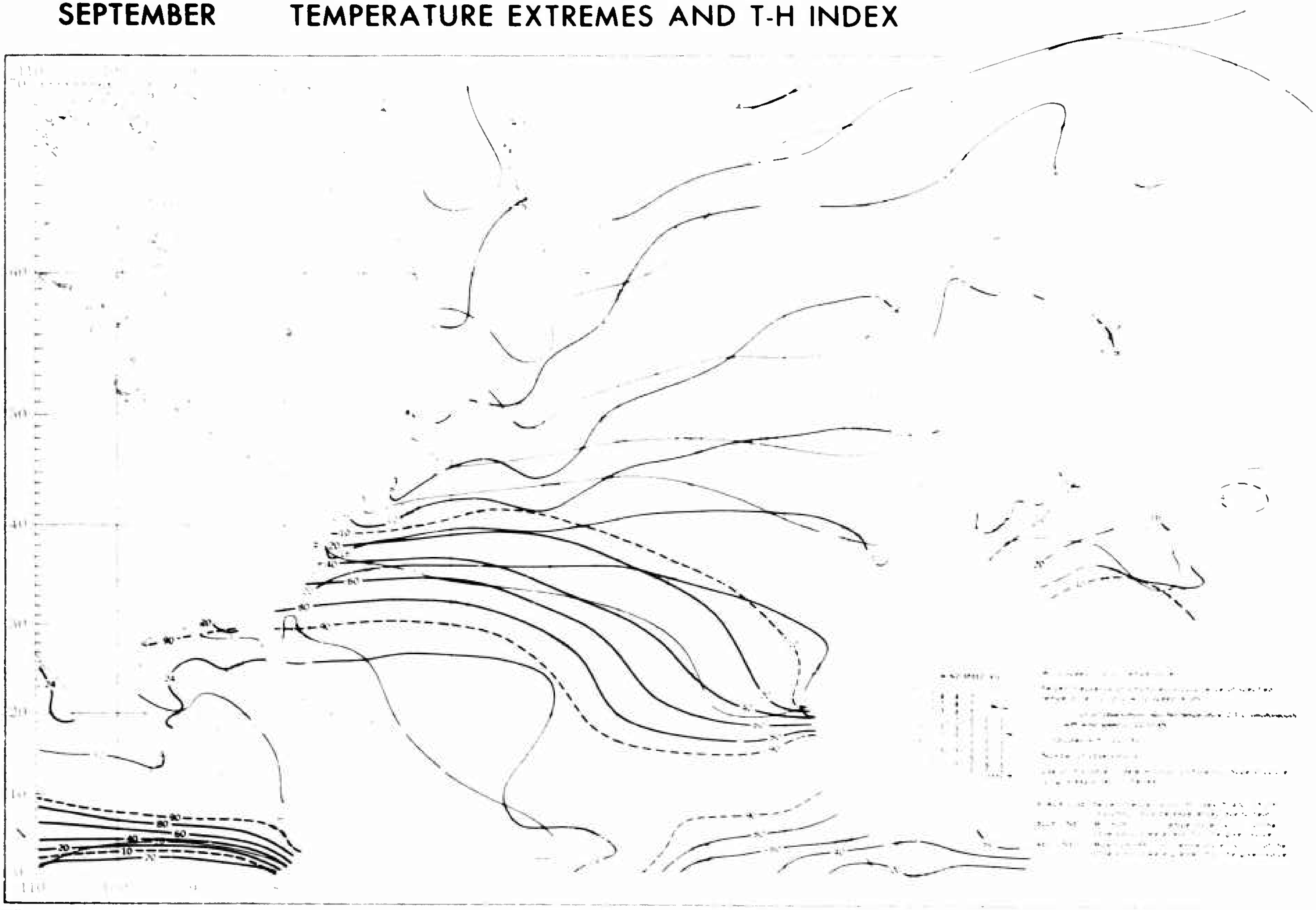


SURFACE AIR TEMPERATURE

SEPTEMBER



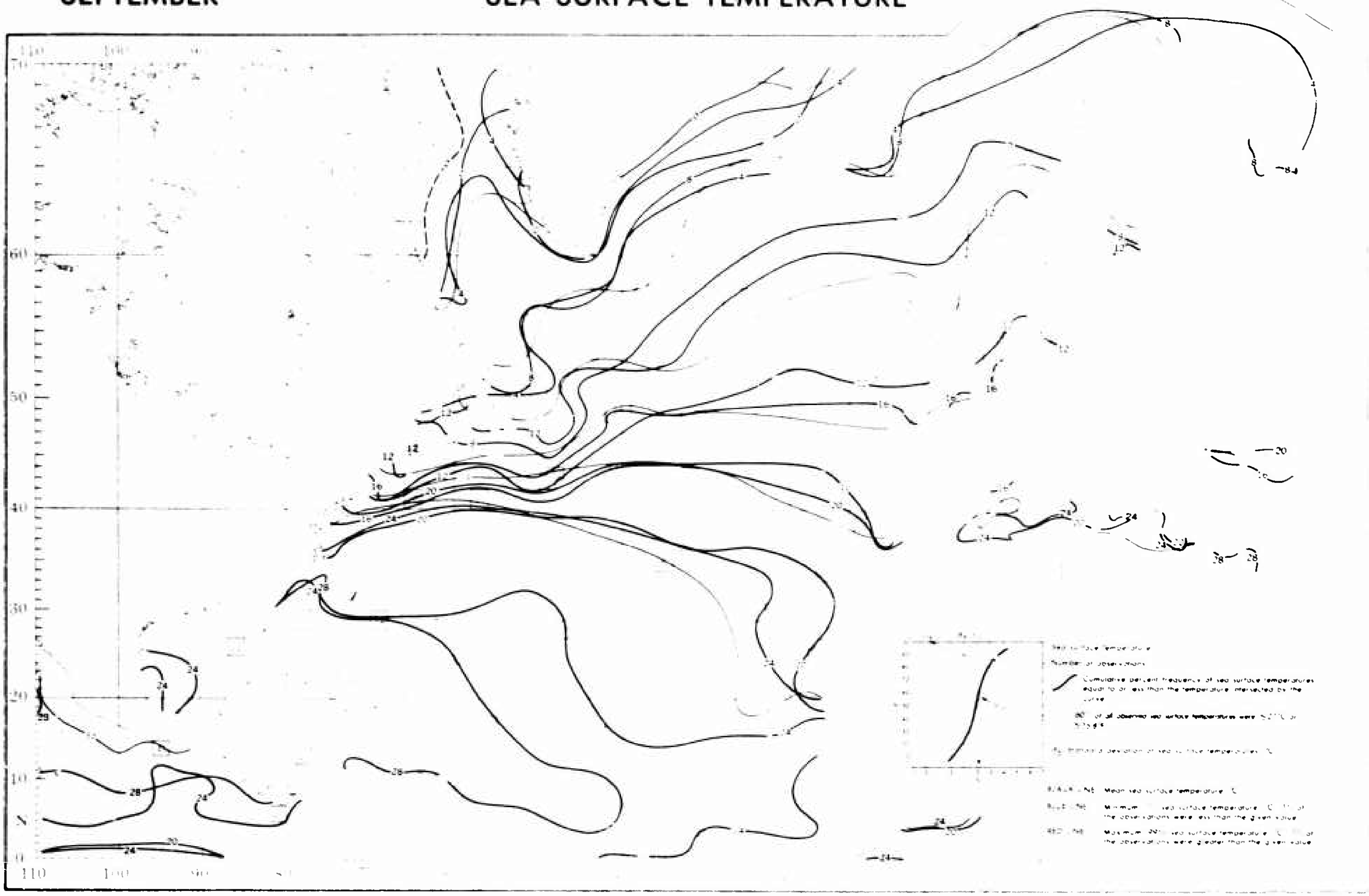
SEPTEMBER TEMPERATURE EXTREMES AND T-H INDEX



WIND SPEED AND AIR TEMPERATURE

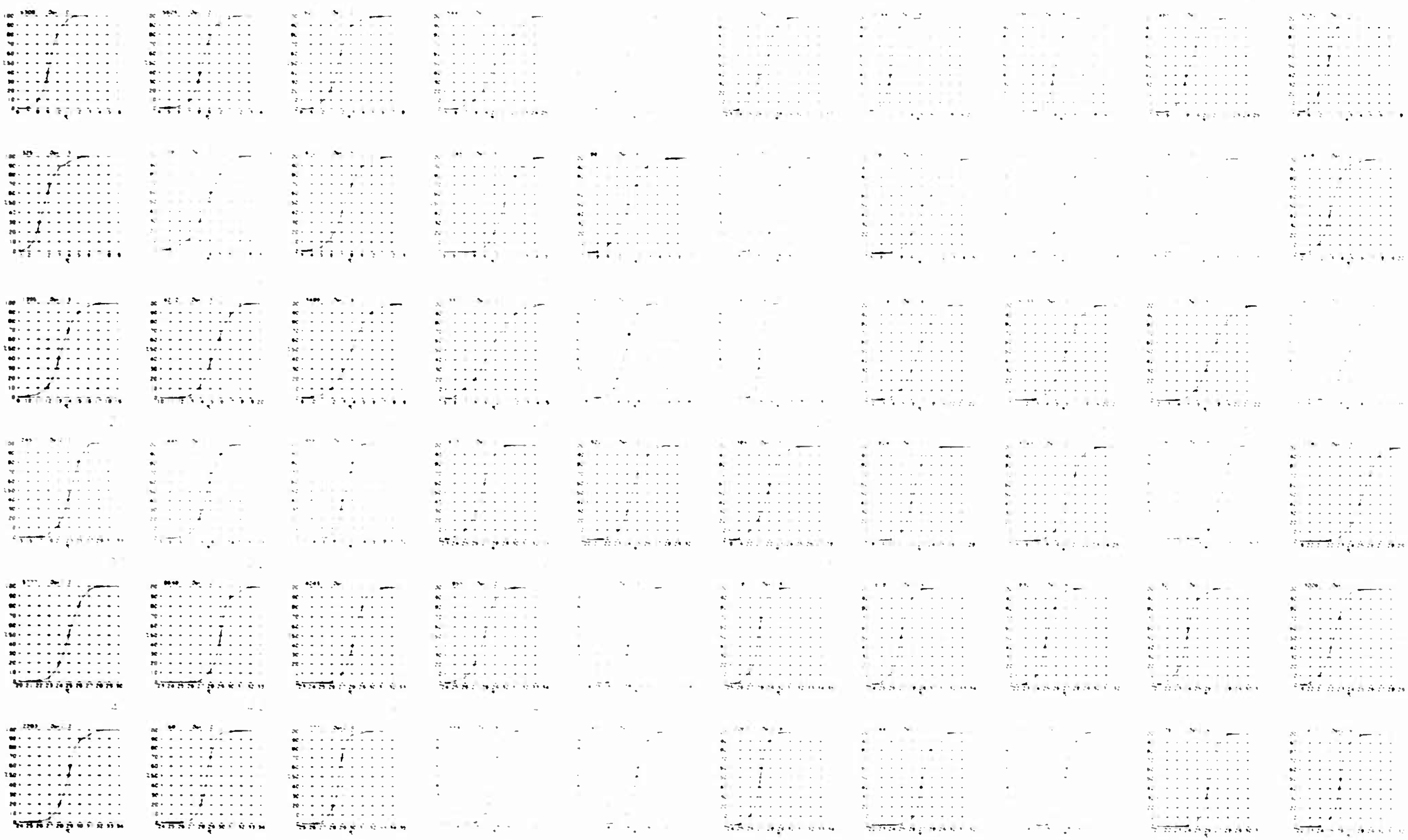
SEPTEMBER

SEPTEMBER SEA SURFACE TEMPERATURE



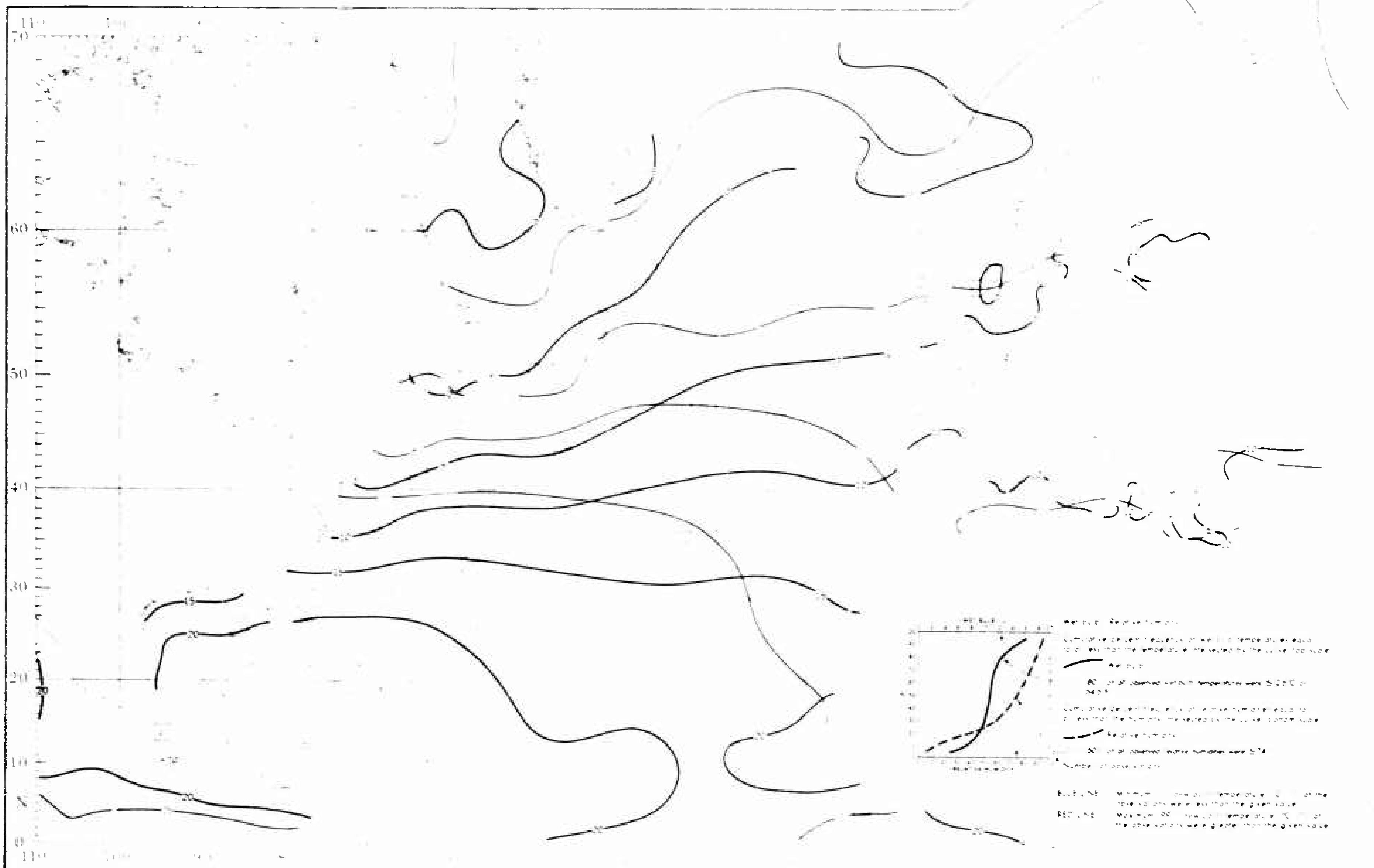
SEA SURFACE TEMPERATURE

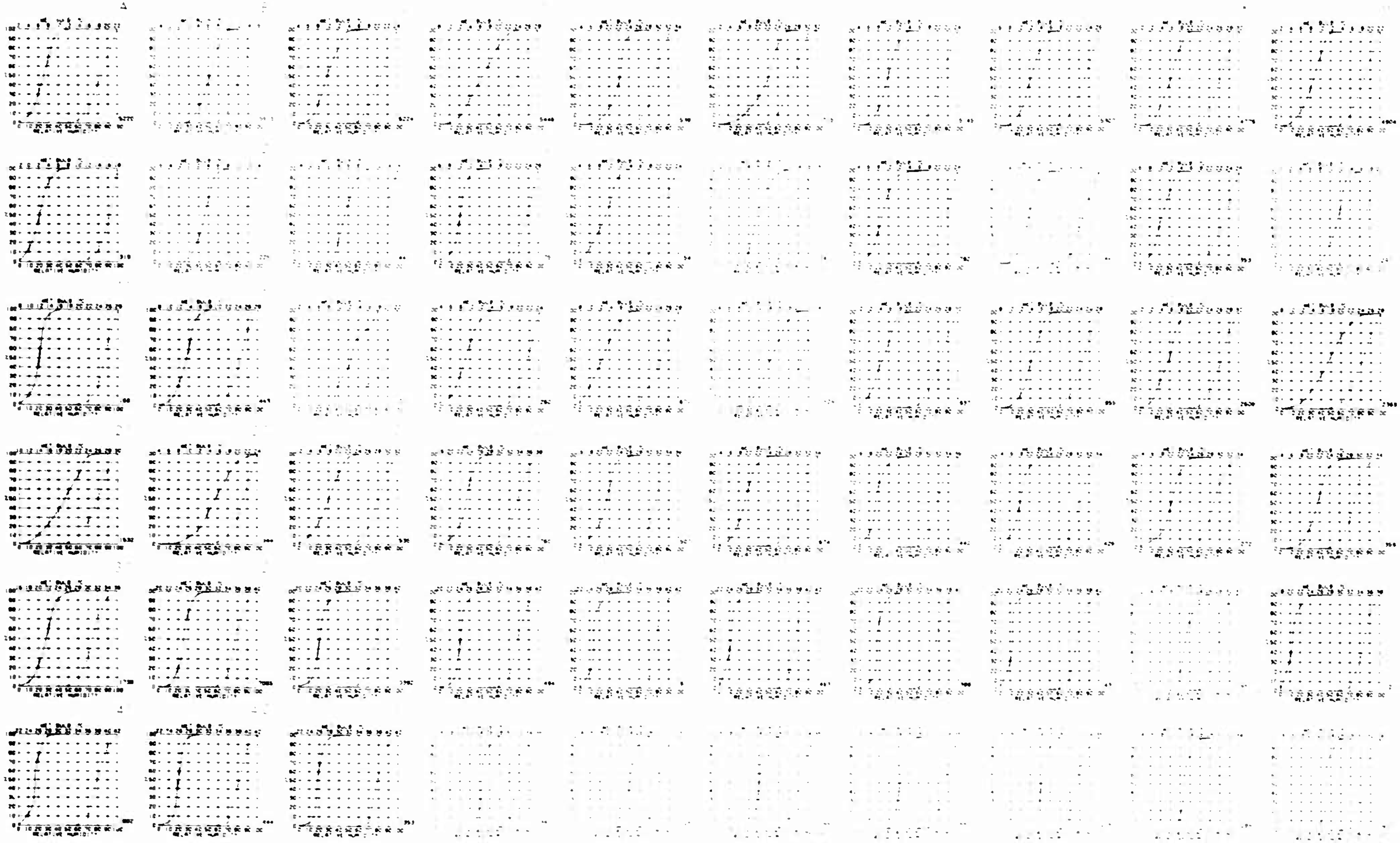
SEPTEMBER



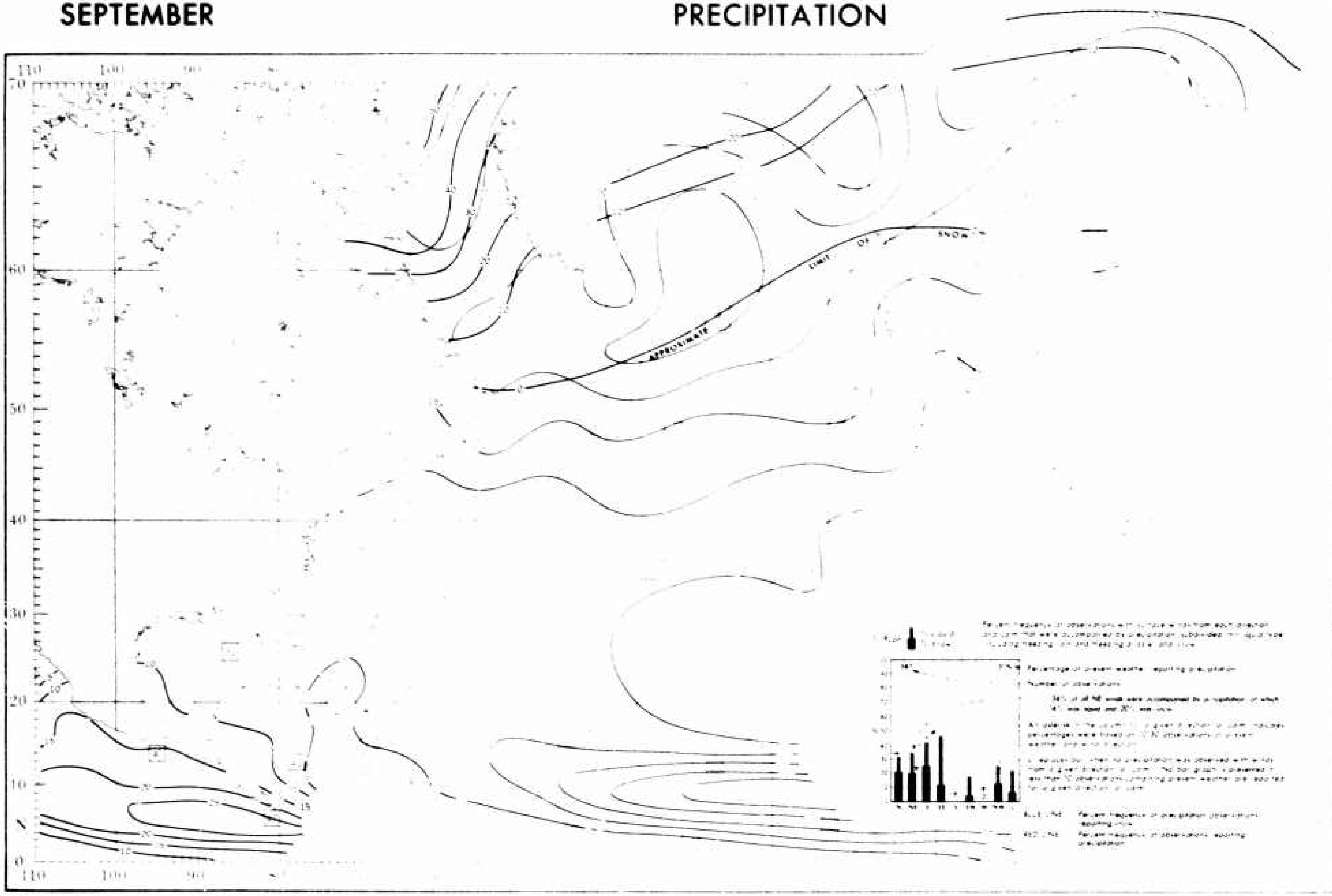
SEPTEMBER

HUMIDITY

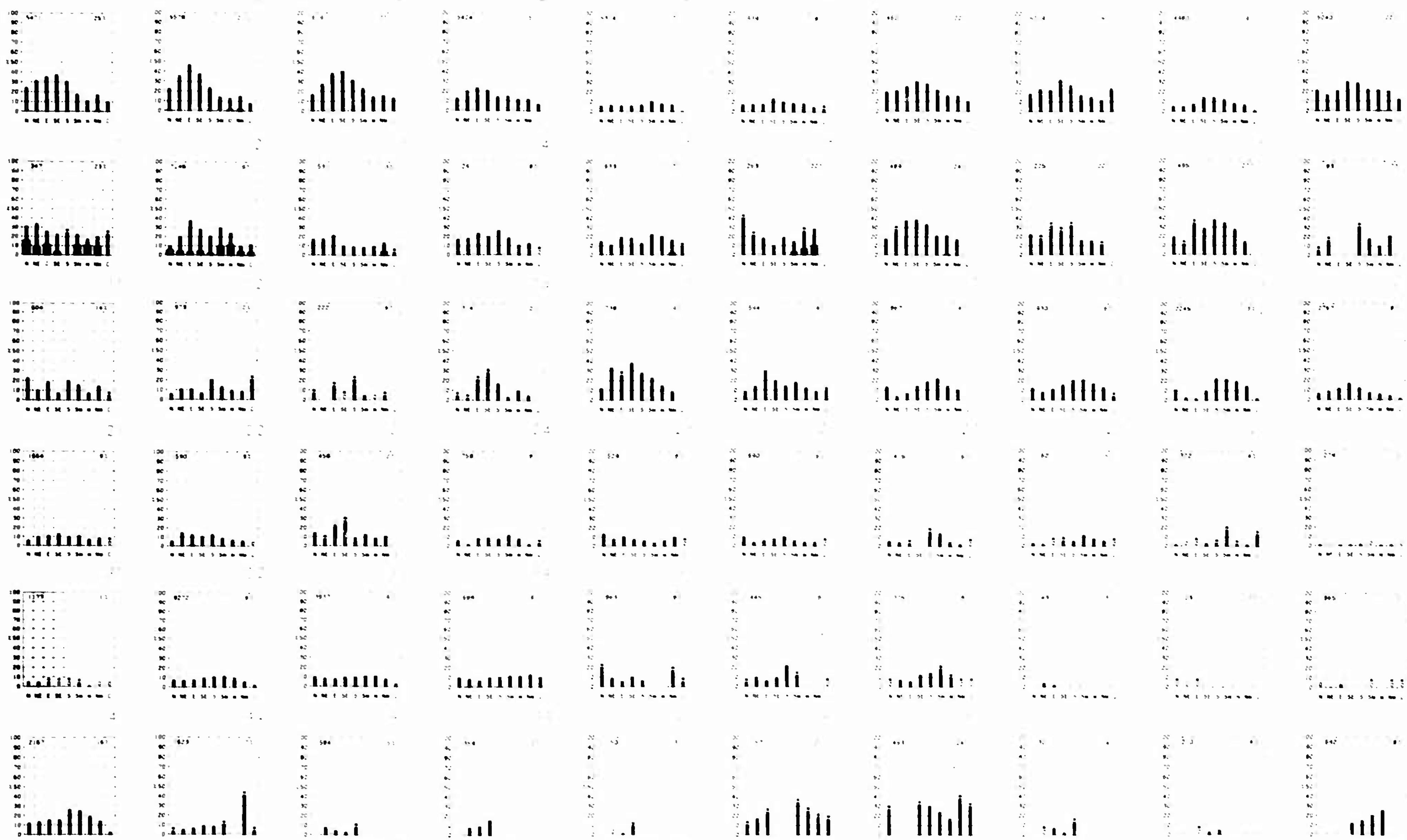




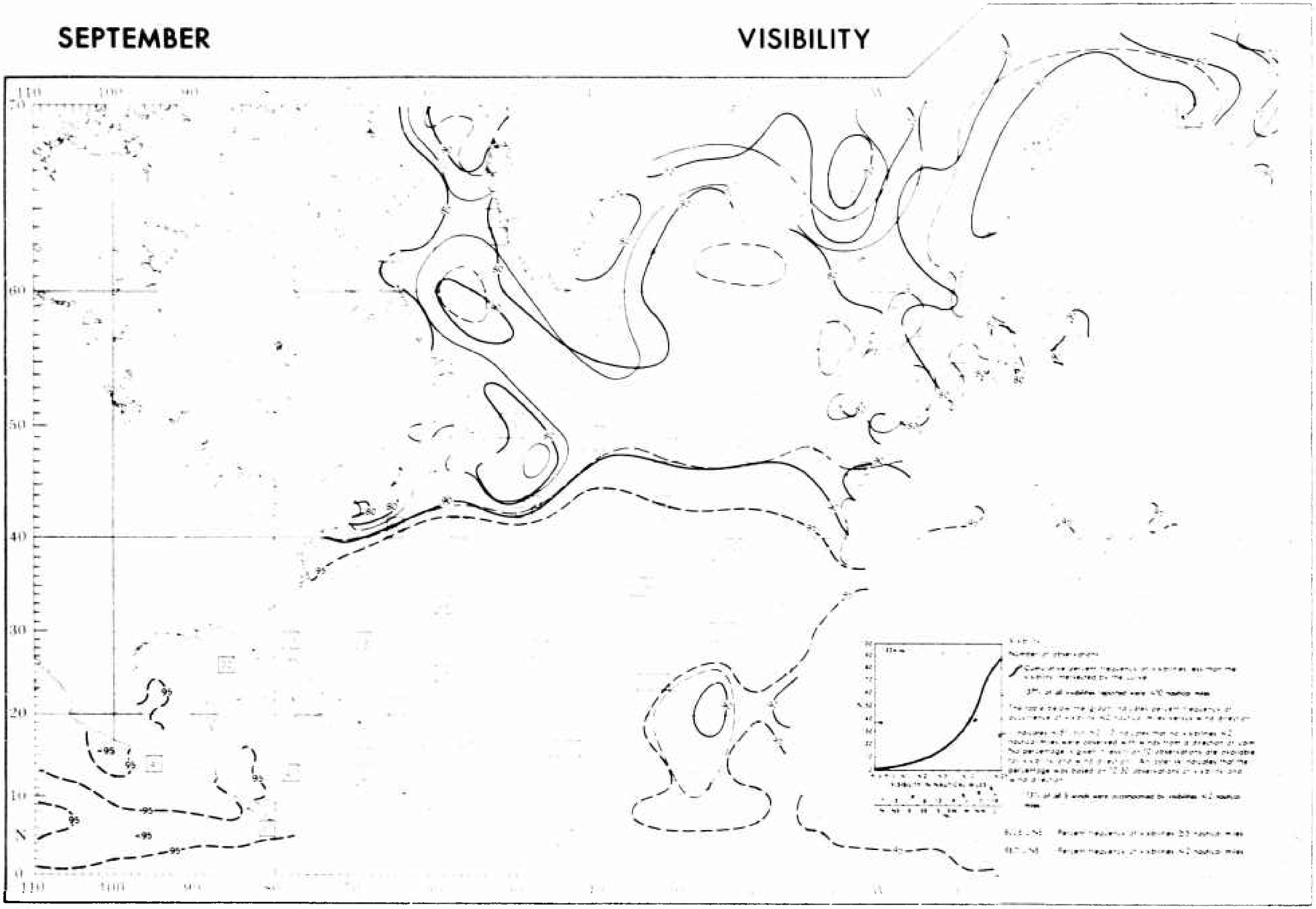
PRECIPITATION



PRECIPITATION SEPTEMBER



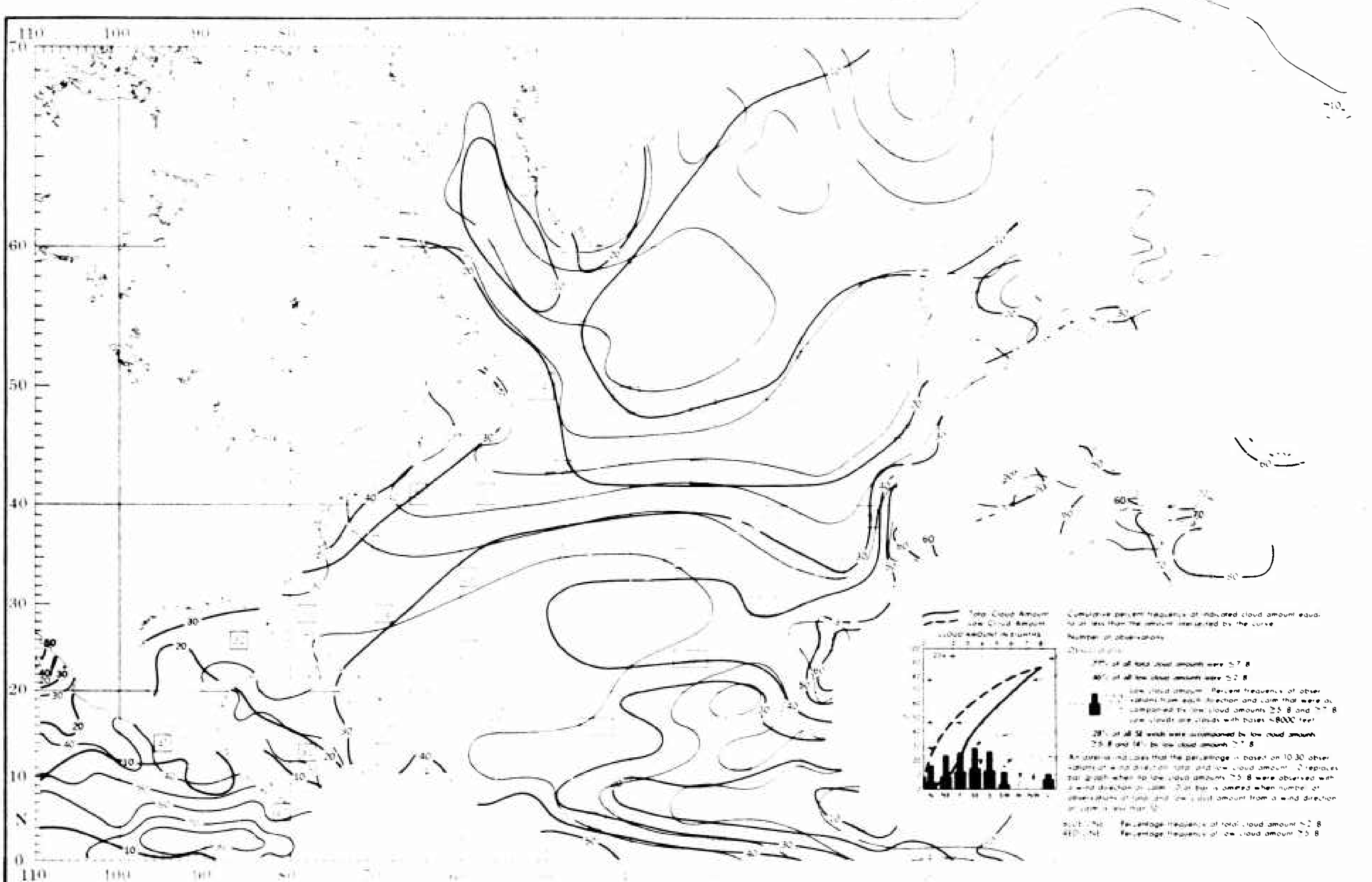
SEPTEMBER VISIBILITY



VISIBILITY

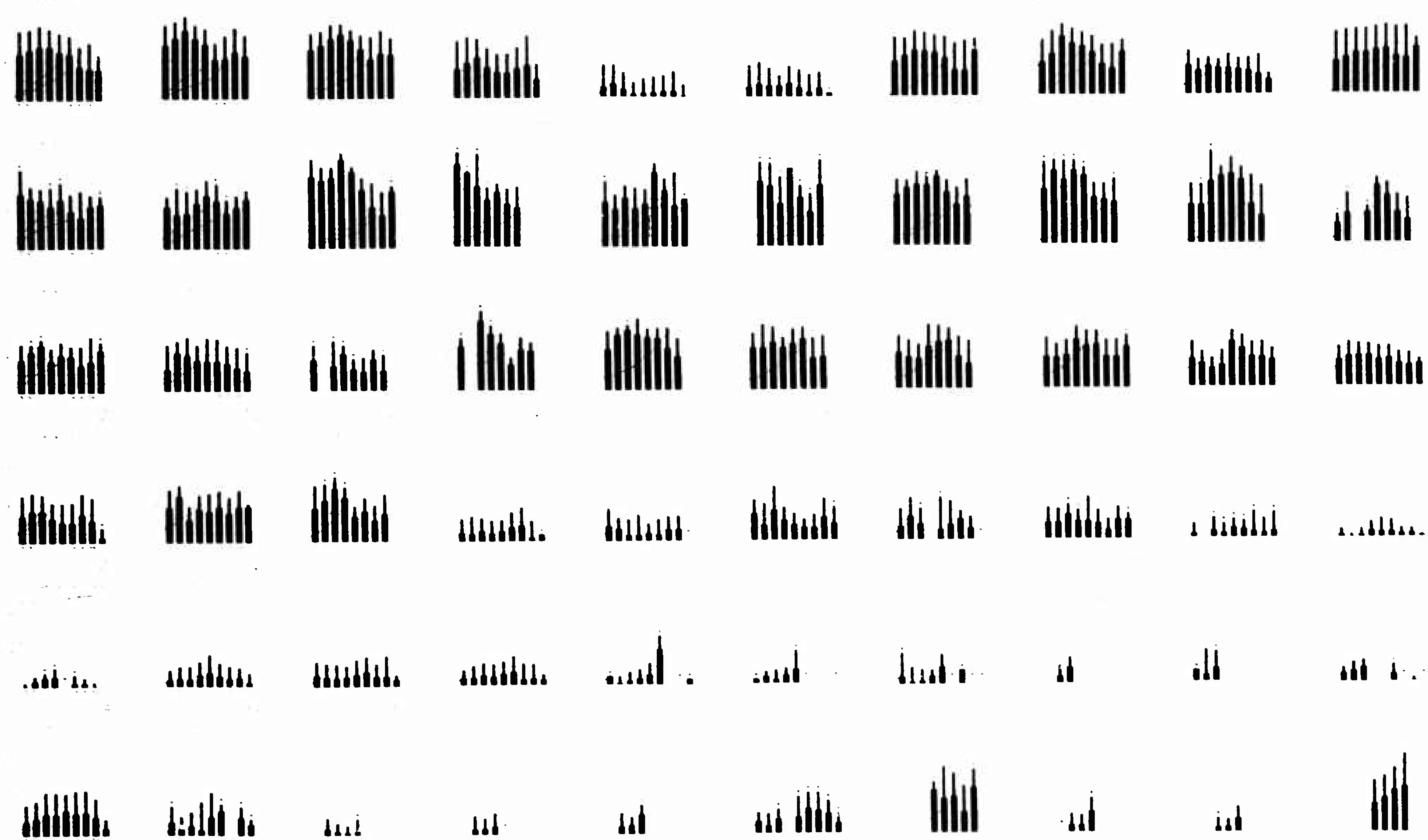
SEPTEMBER

SEPTEMBER CLOUD COVER



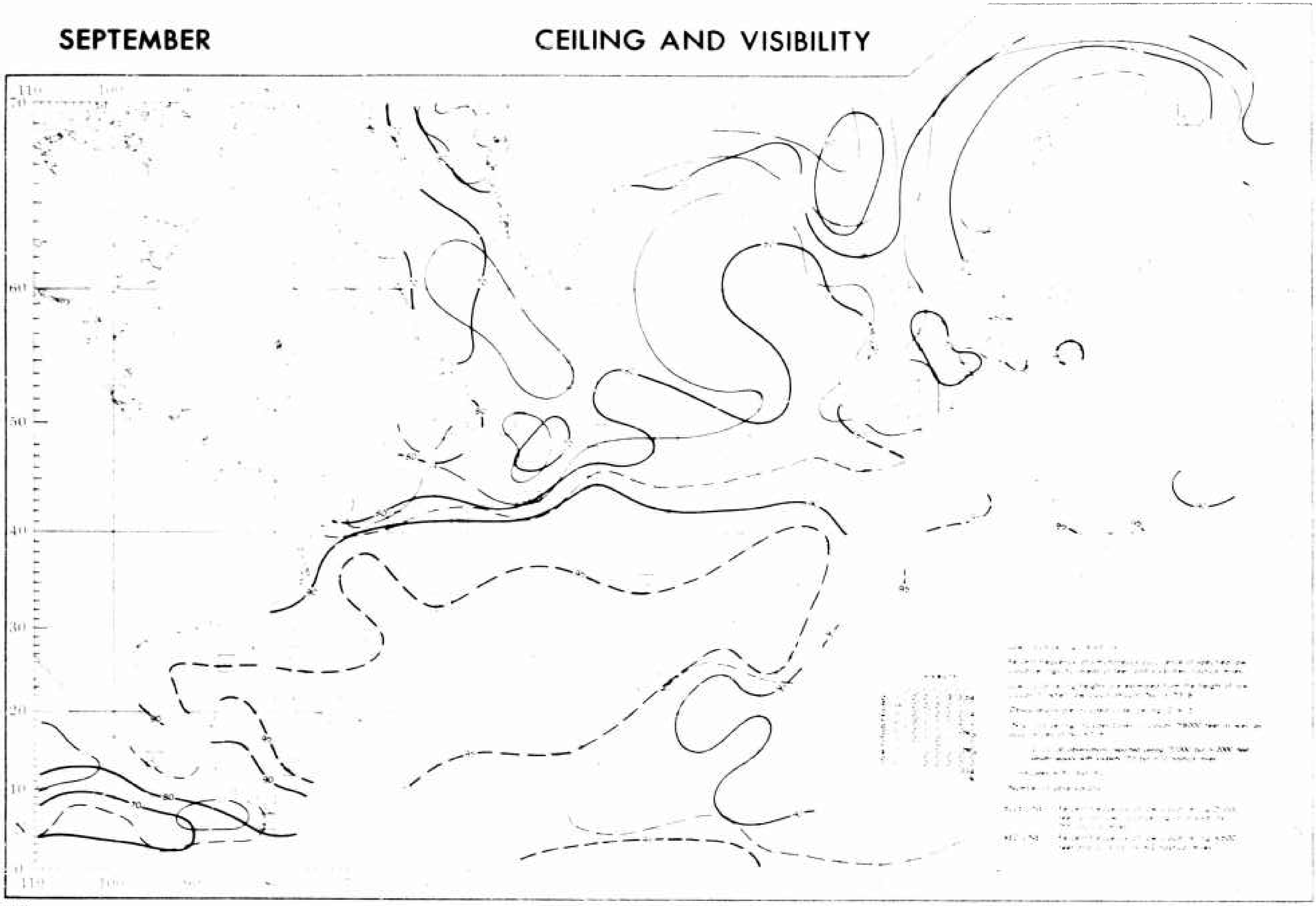
CLOUD COVER

SEPTEMBER



SEPTEMBER

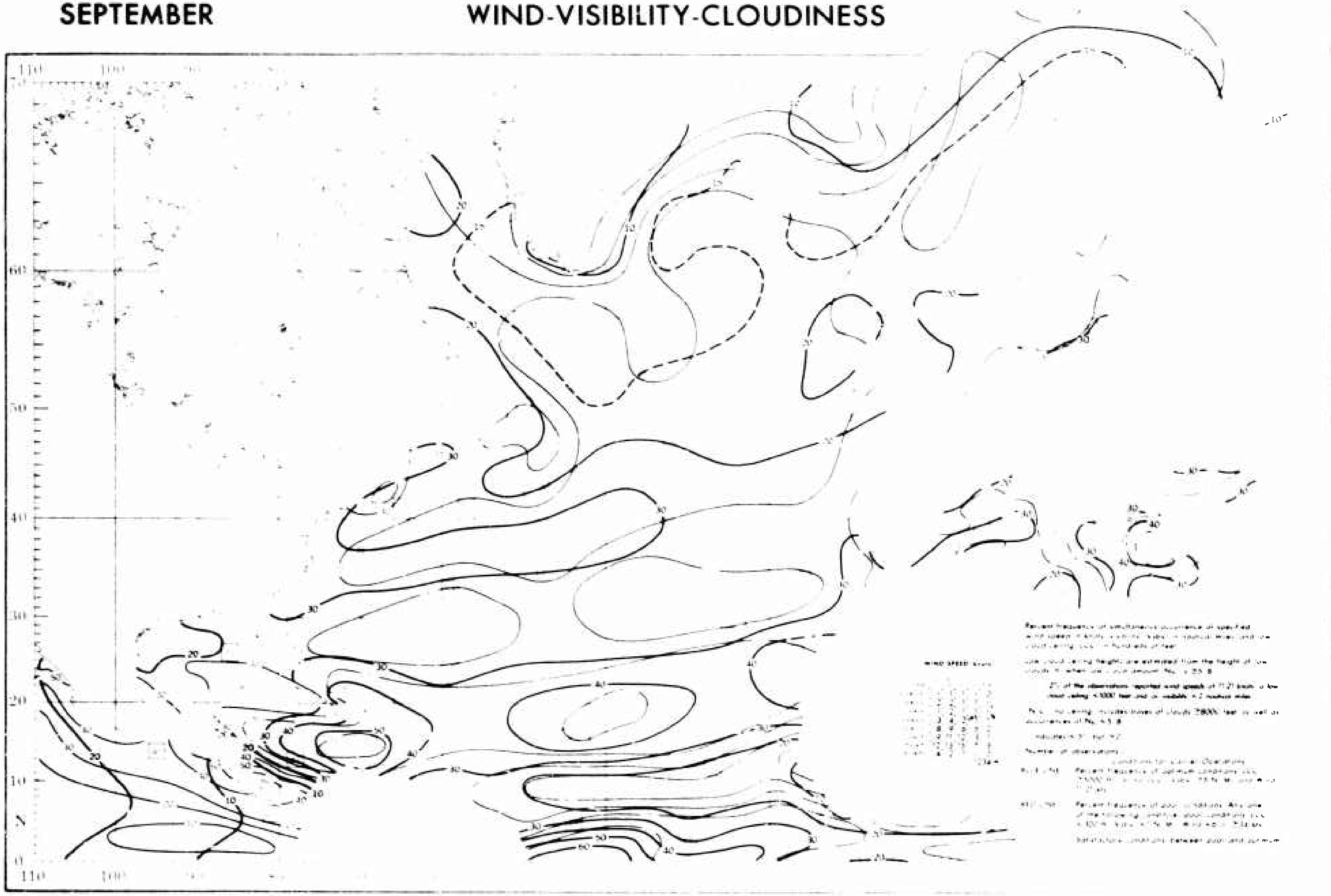
CEILING AND VISIBILITY



CEILING AND VISIBILITY

SEPTEMBER

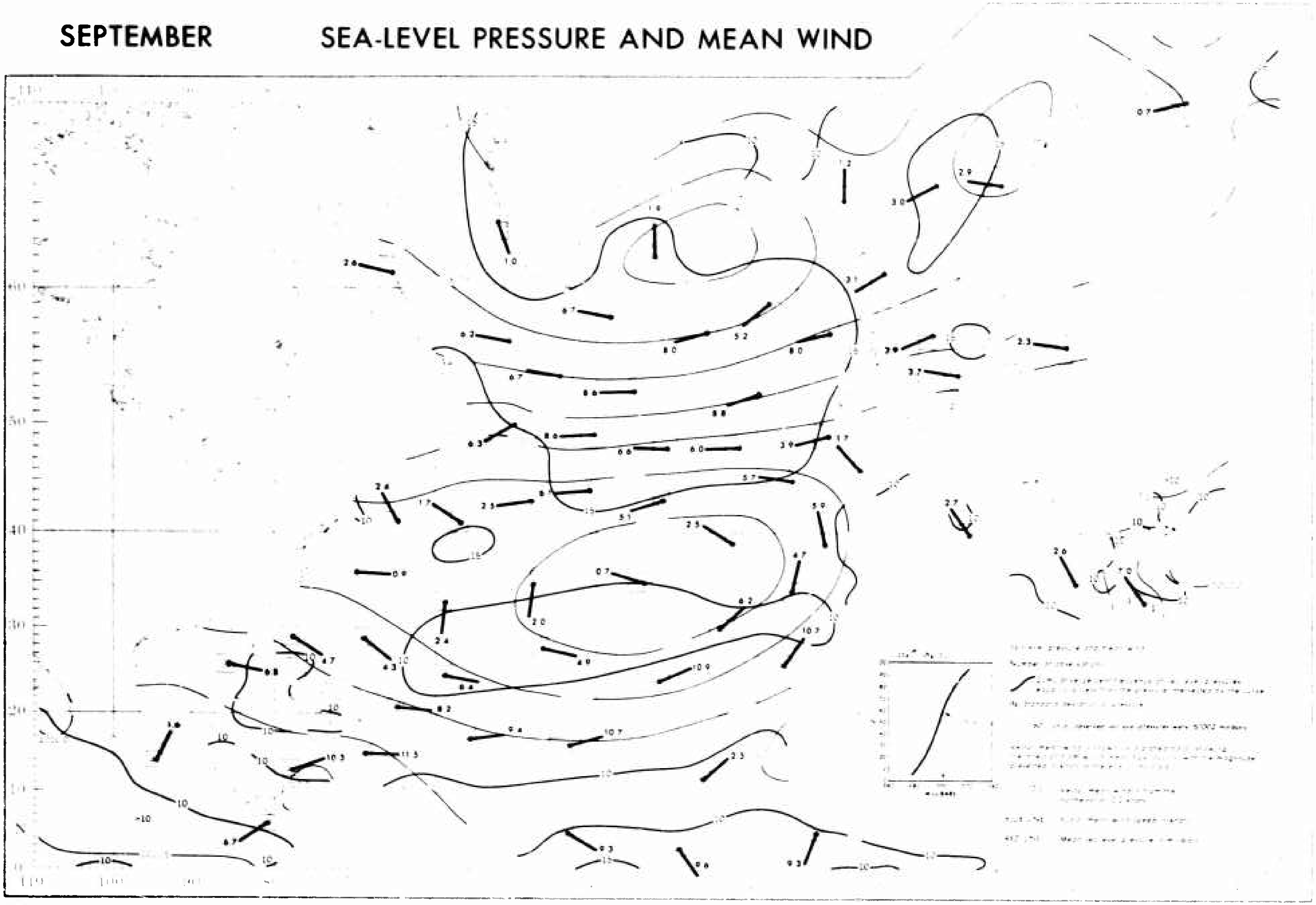
WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

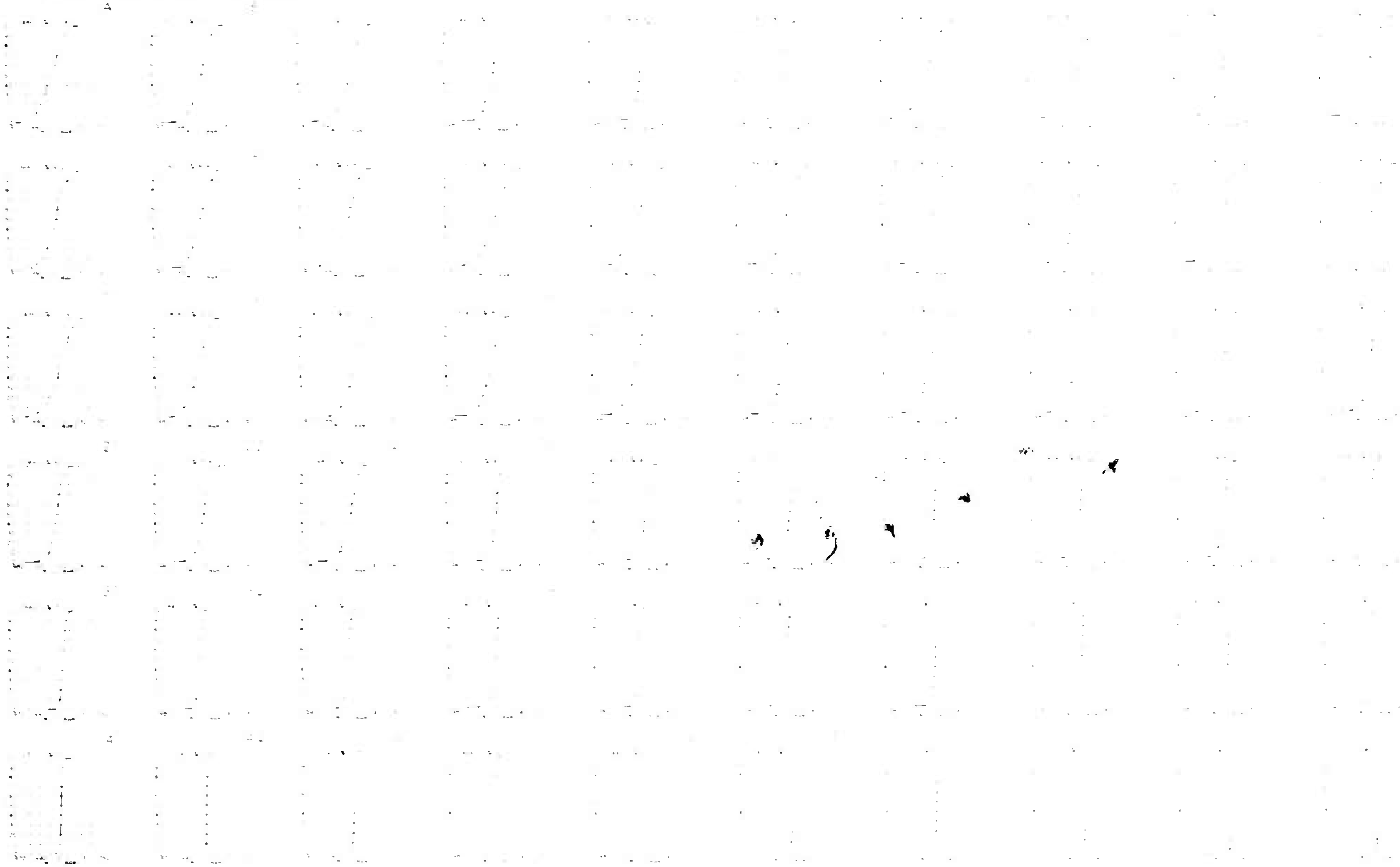
SEPTEMBER

SEPTEMBER SEA-LEVEL PRESSURE AND MEAN WIND

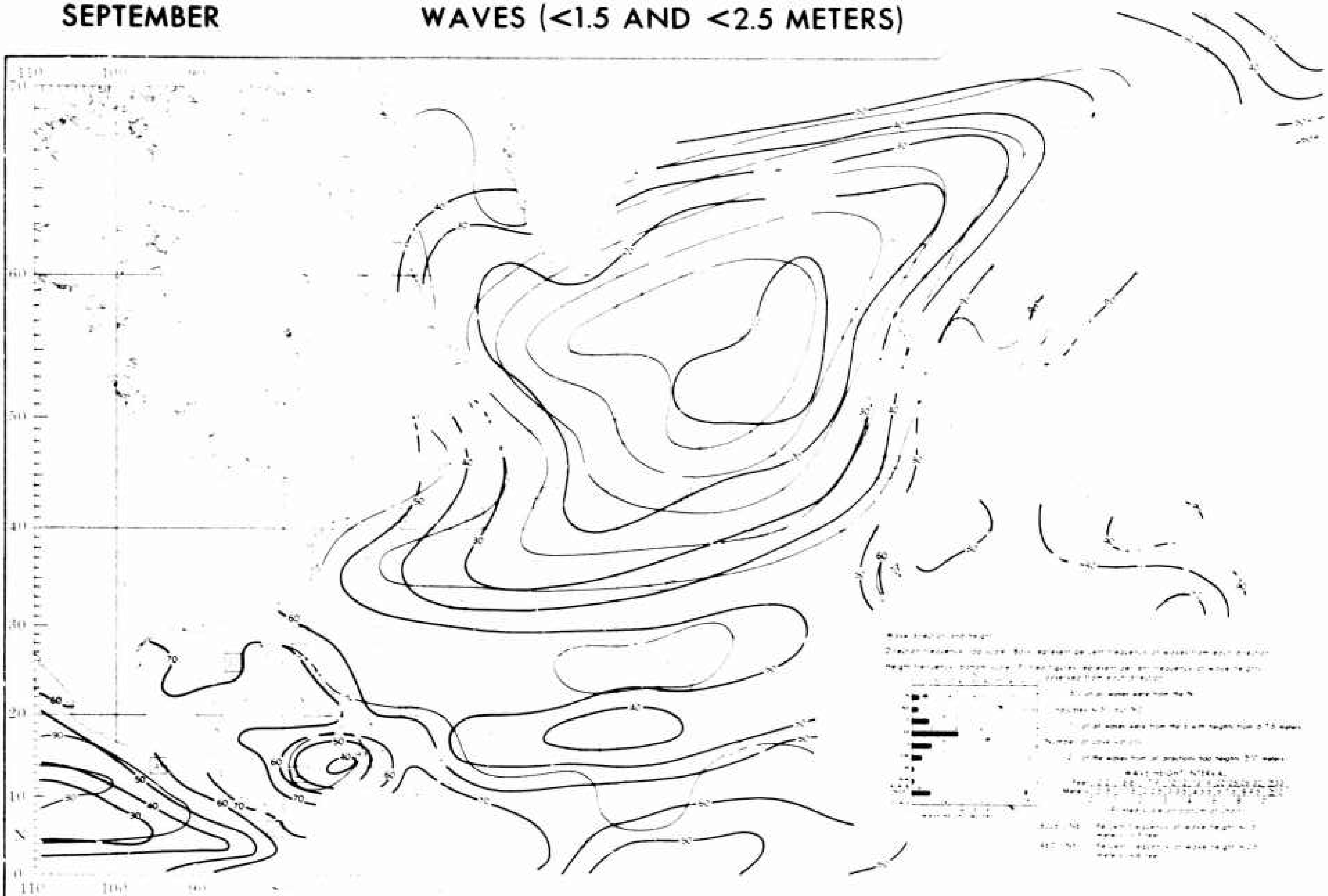


SEA LEVEL PRESSURE

SEPTEMBER

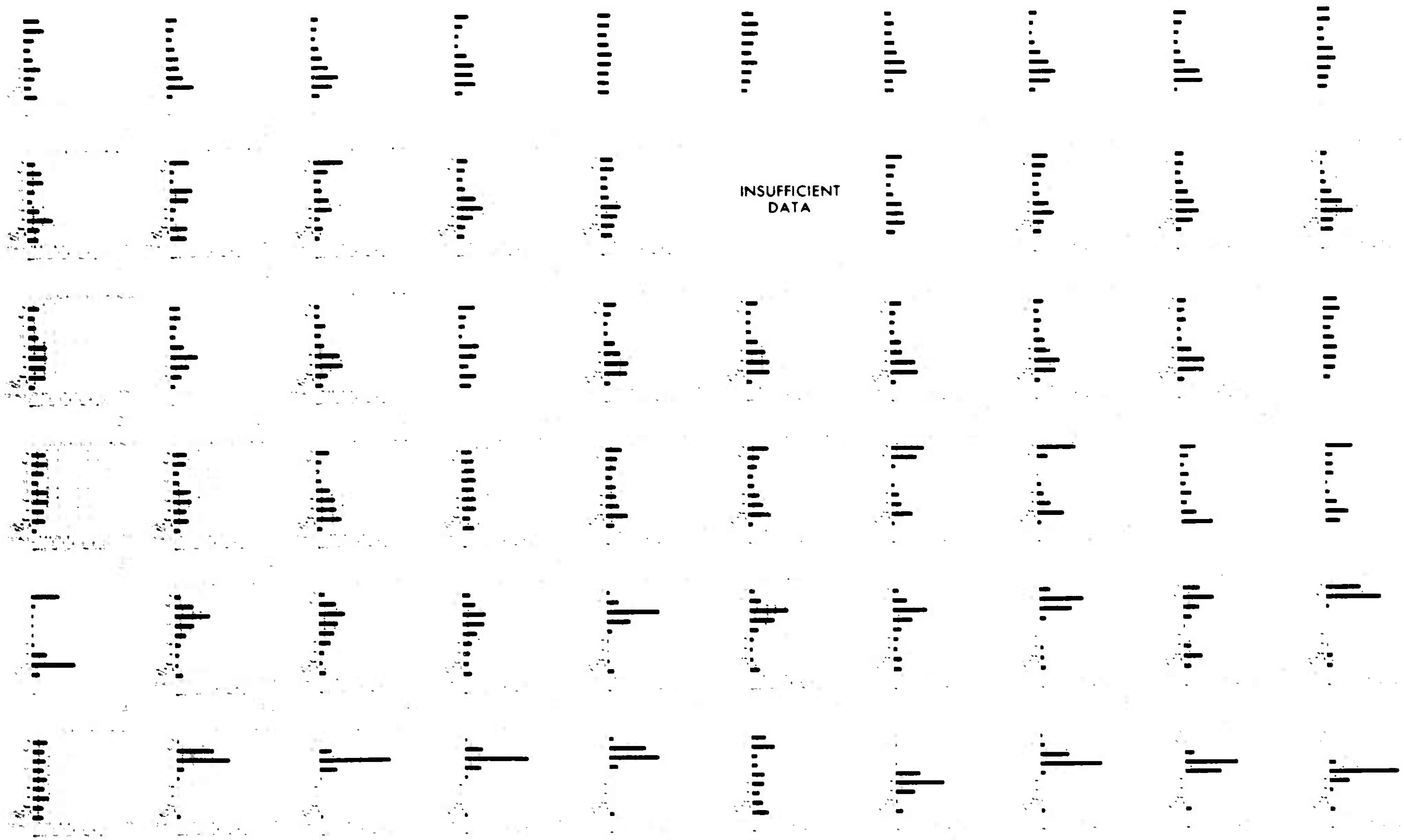


SEPTEMBER WAVES (<1.5 AND <2.5 METERS)



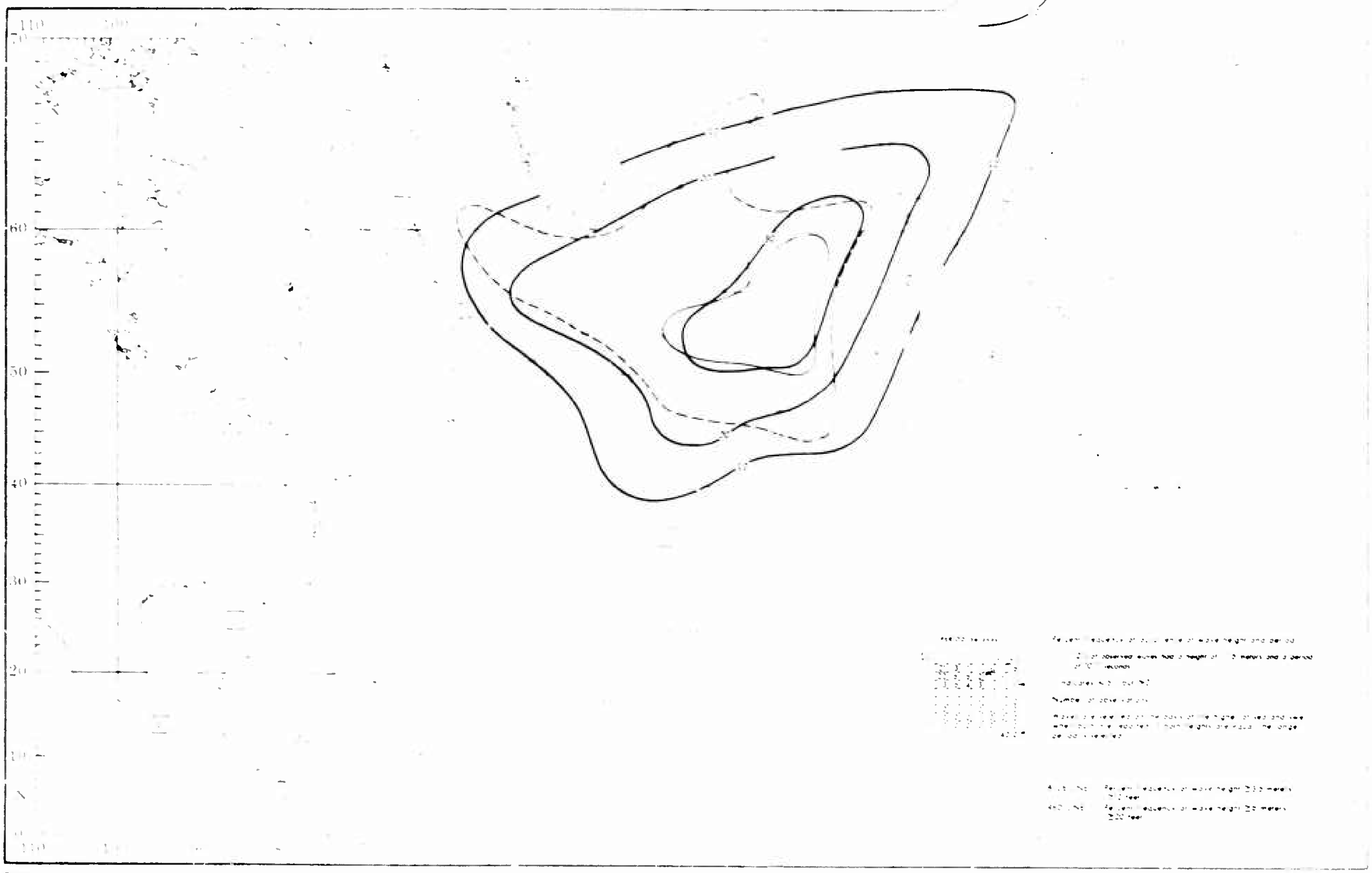
WAVE DIRECTION AND HEIGHT

SEPTEMBER



SEPTEMBER

WAVES (≥3.5 AND ≥6 METERS)



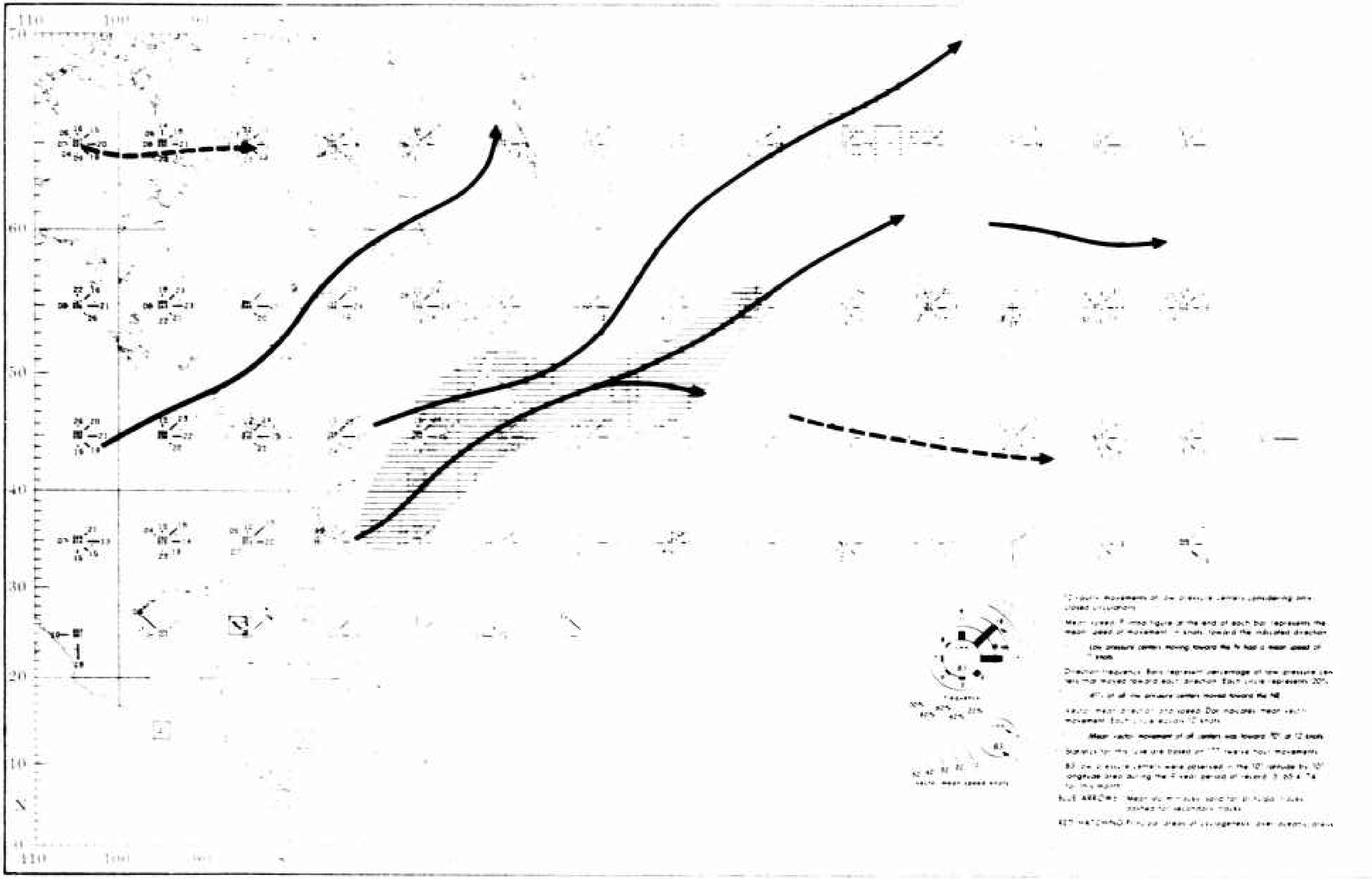
WAVE PERIOD AND HEIGHT

SEPTEMBER

INSUFFICIENT
DATA

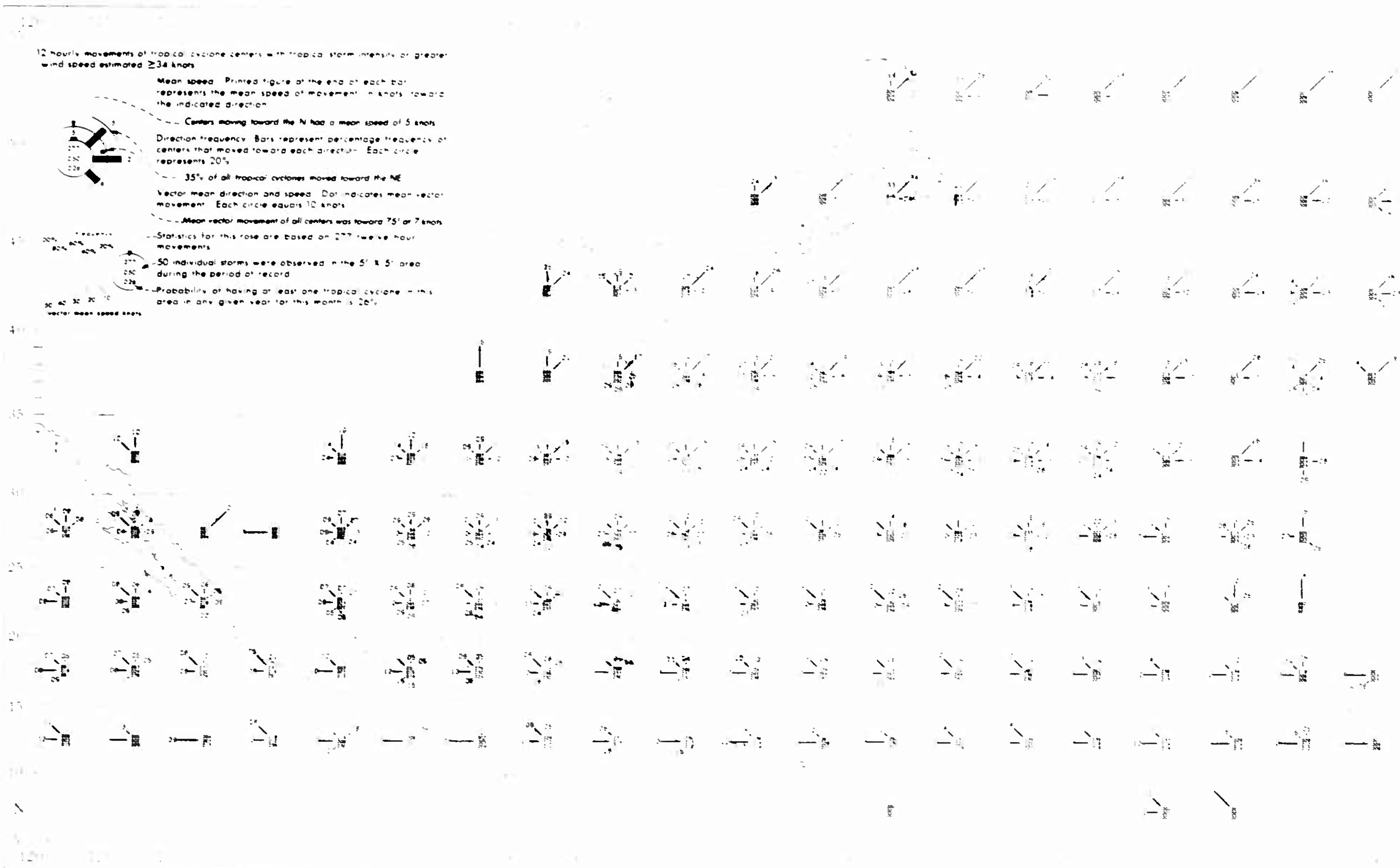
SEPTEMBER

LOW PRESSURE CENTERS



TROPICAL CYCLONE

SEPTEMBER



12 hourly movements of tropical cyclone centers with tropical storm intensity or greater wind speed estimated ≥34 knots

Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

— Centers moving toward the N had a mean speed of 5 knots

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

— 35% of all tropical cyclones moved toward the NE

Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

— Mean vector movement of all centers was toward 75° at 7 knots

— Statistics for this rose are based on 277 twelve hour movements

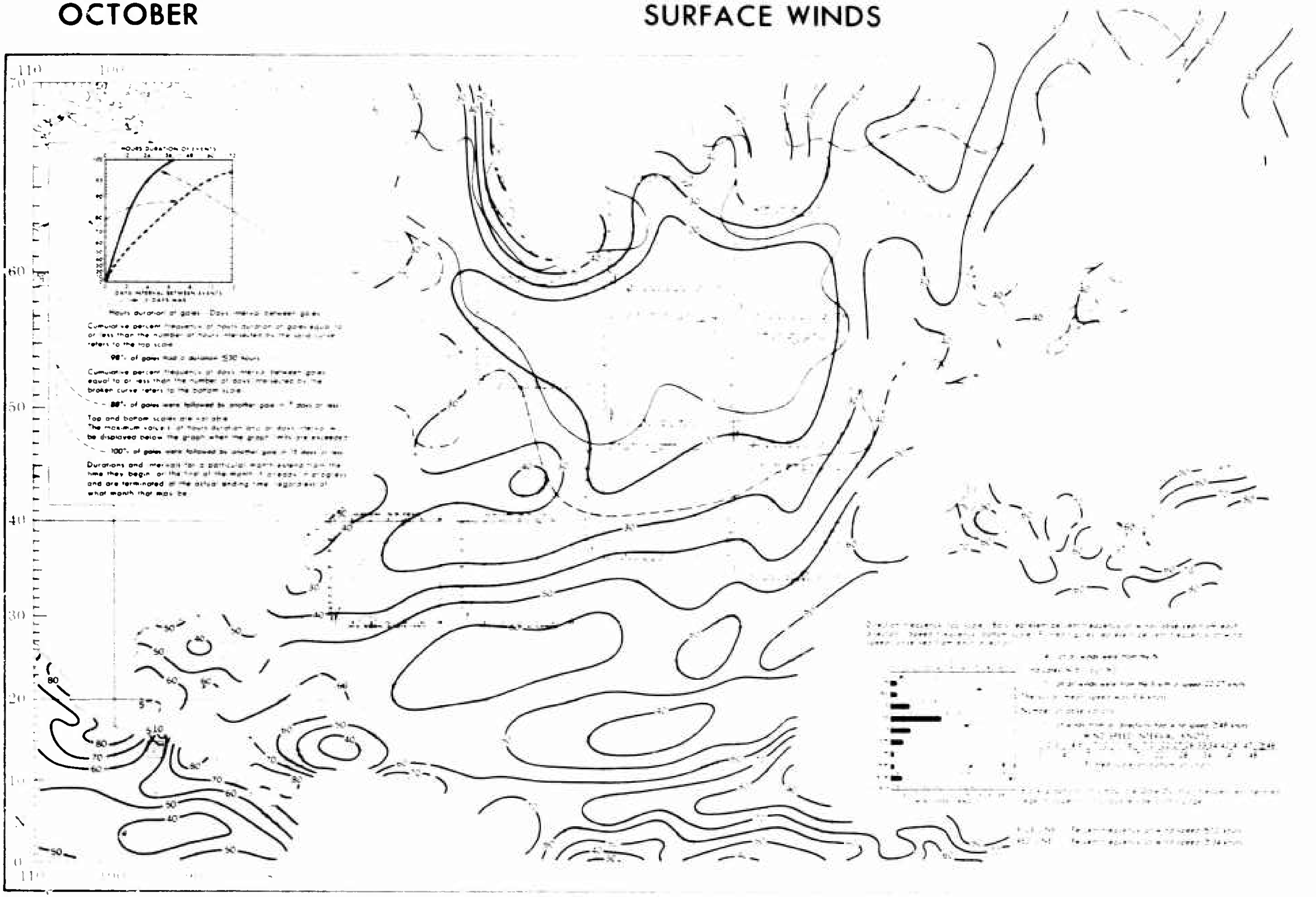
— 50 individual storms were observed in the 5° X 5° area during the period of record

— Probability of having at least one tropical cyclone in this area in any given year for this month is 26%

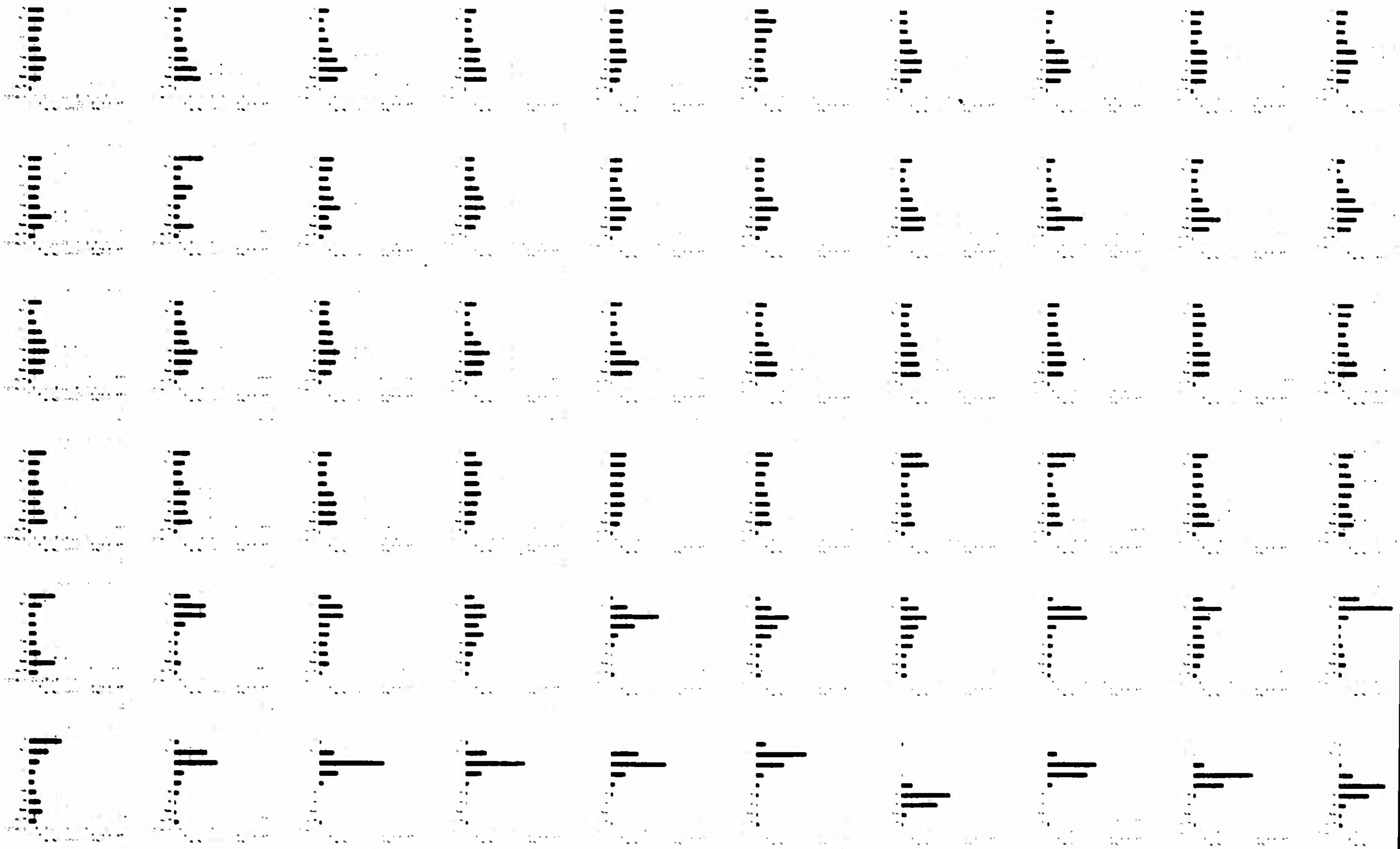
Vector mean speed knots

OCTOBER

SURFACE WINDS

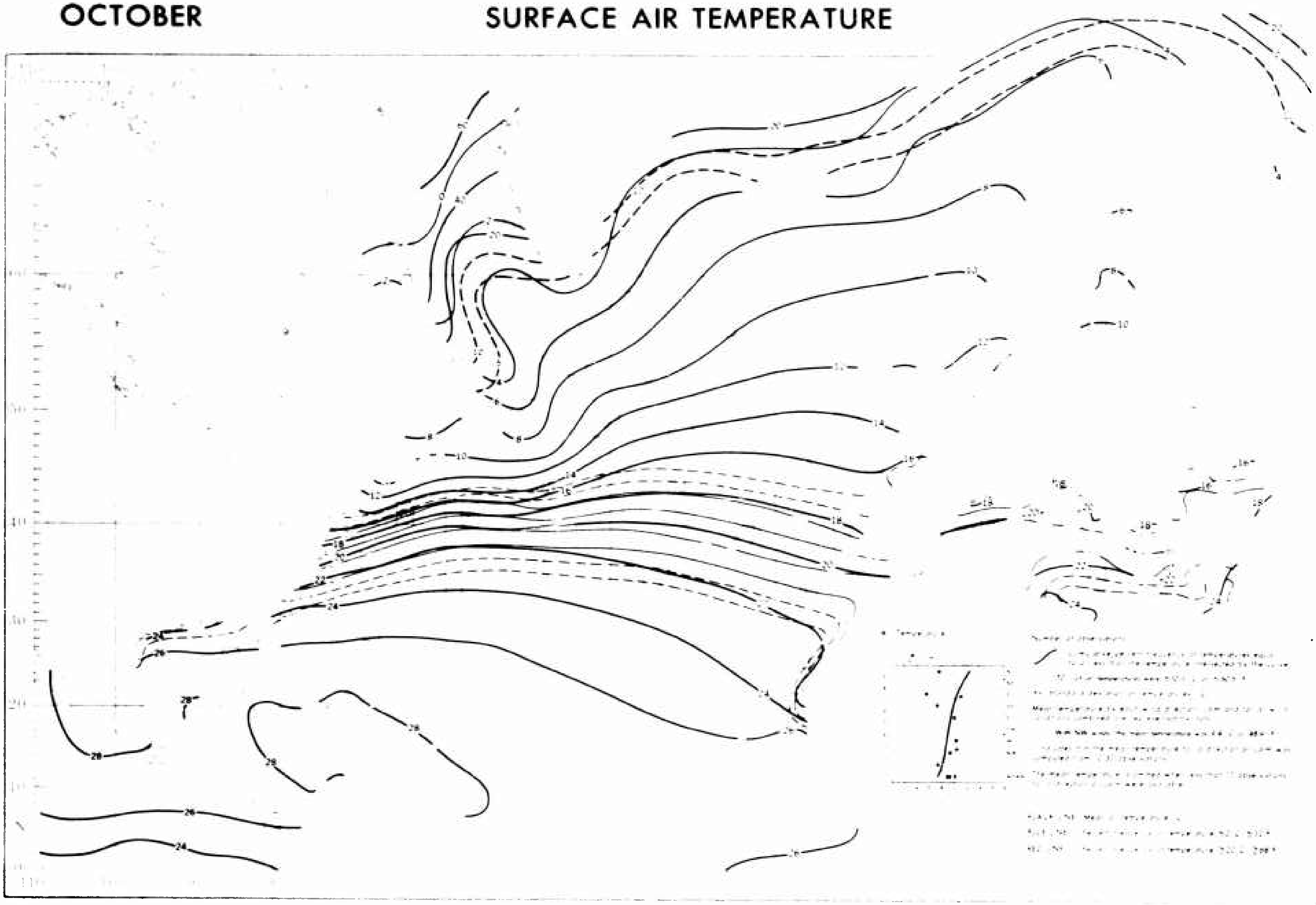


WIND DIRECTION AND SPEED OCTOBER



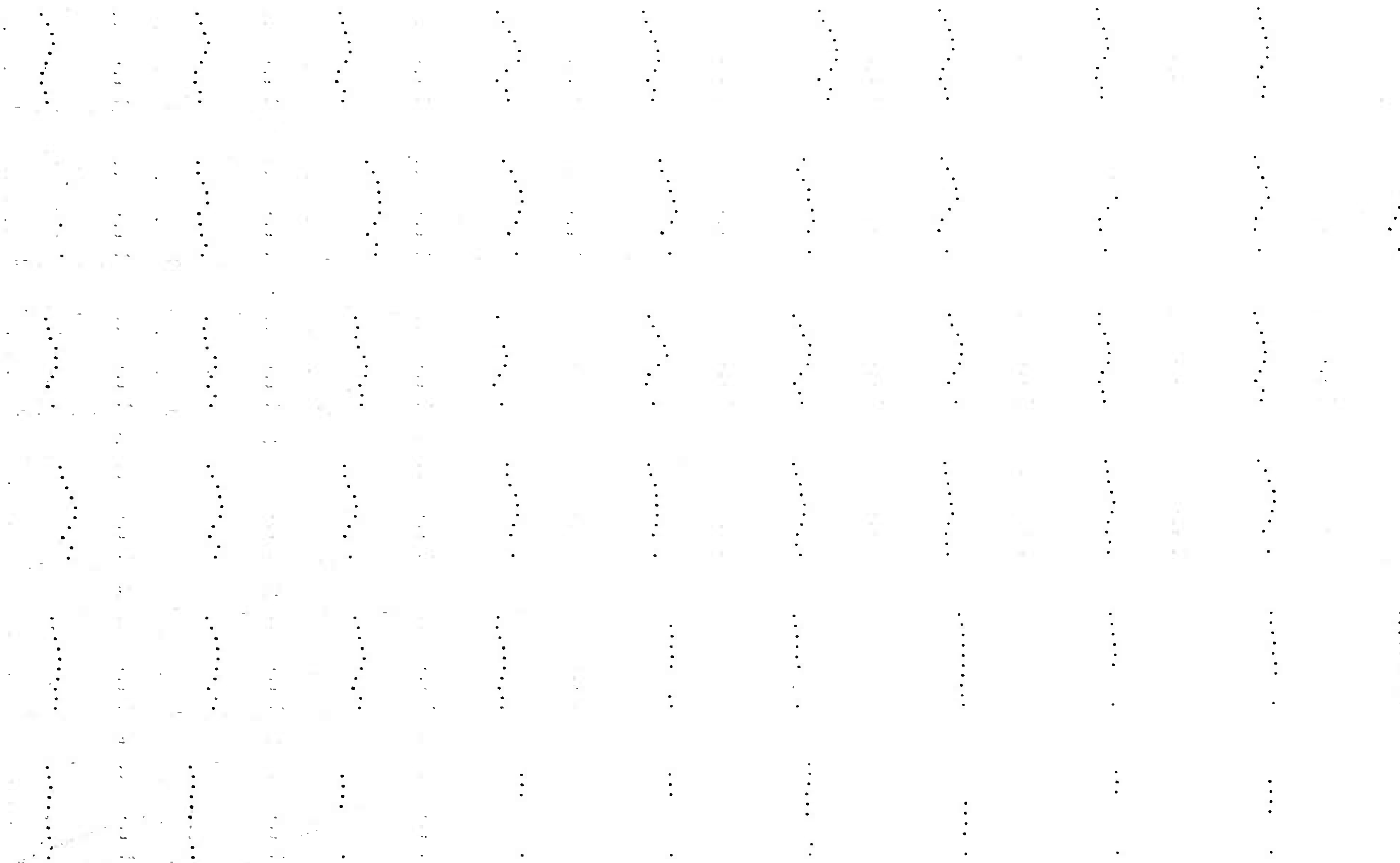
OCTOBER

SURFACE AIR TEMPERATURE

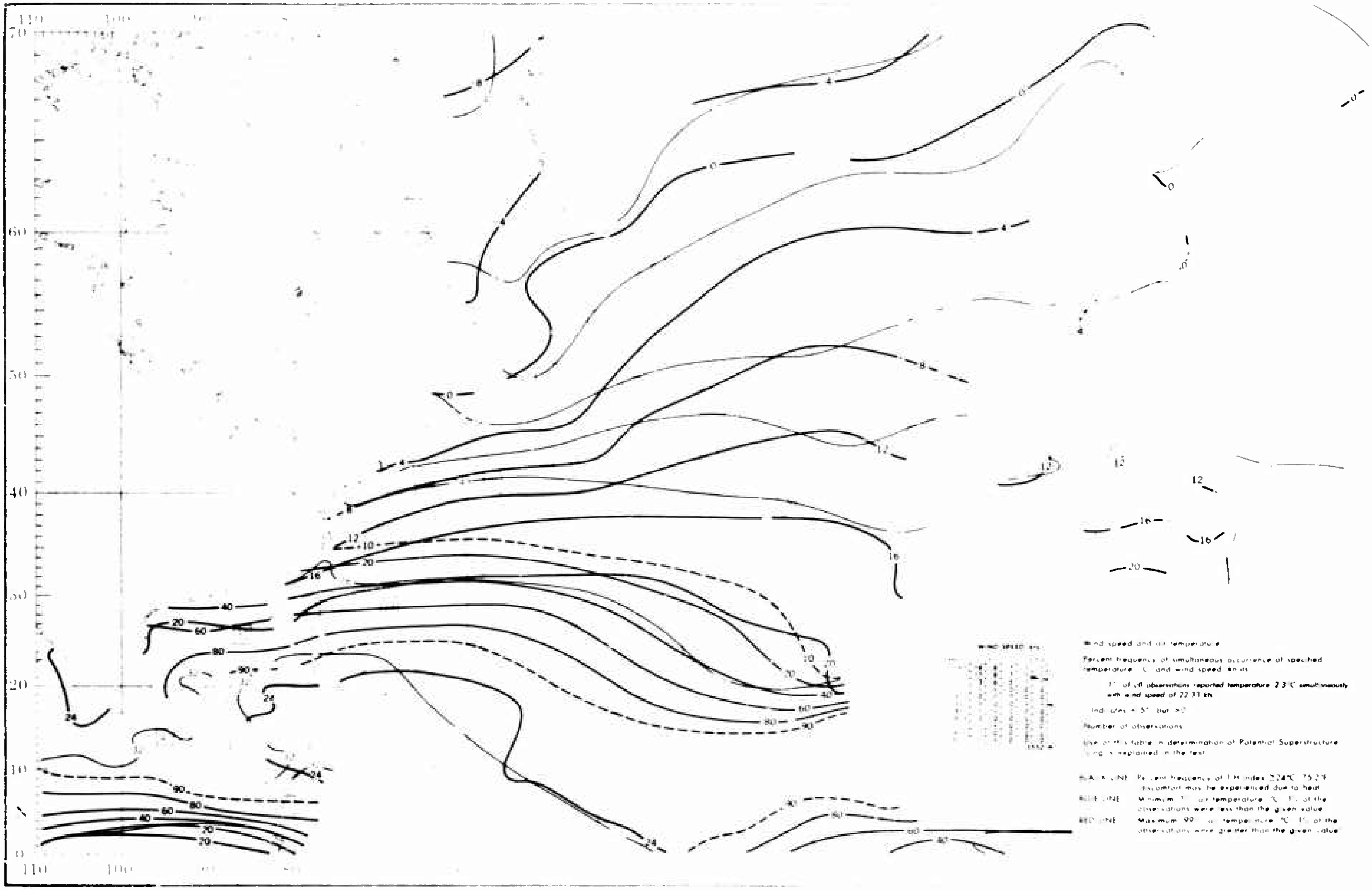


SURFACE AIR TEMPERATURE

OCTOBER



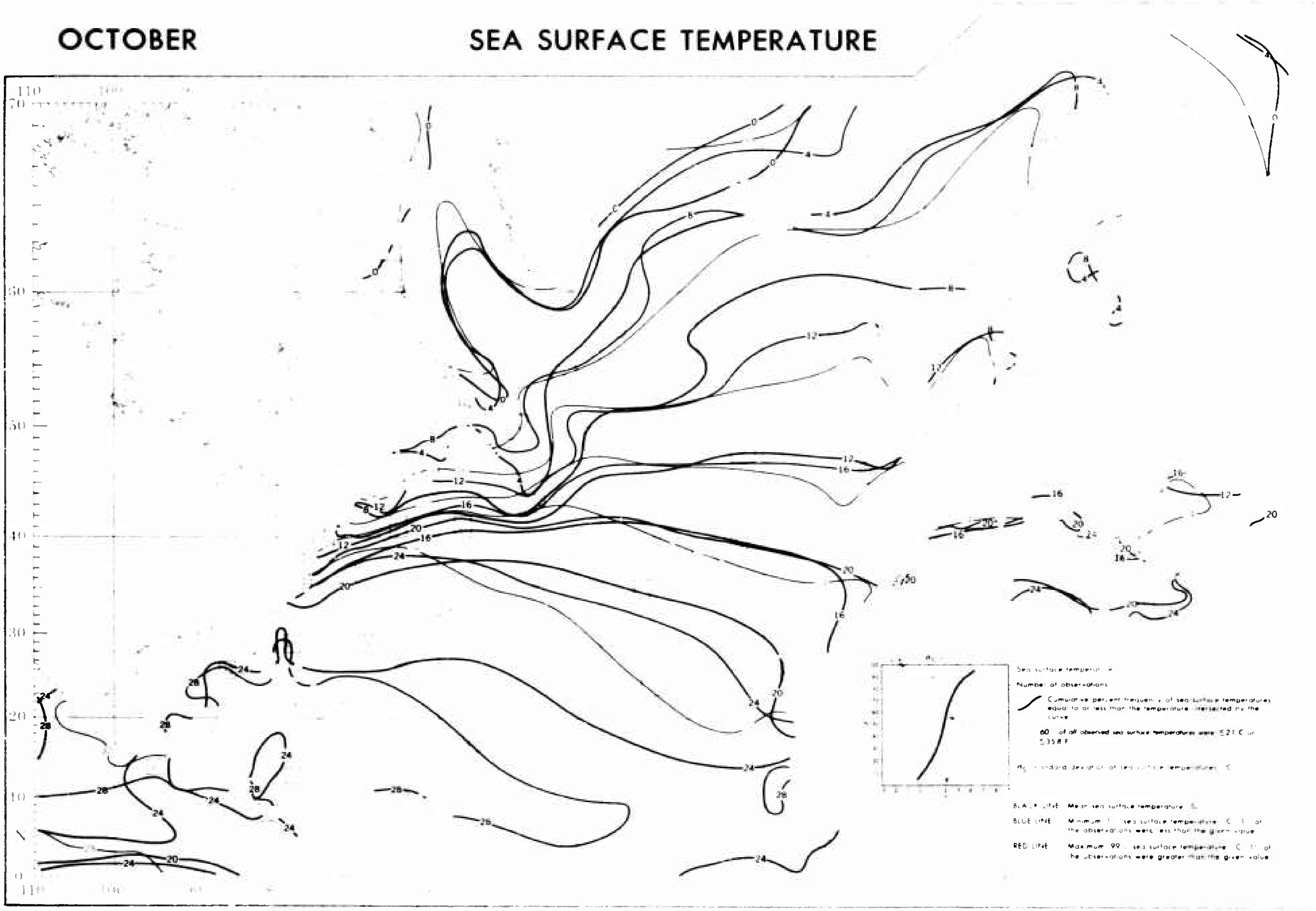
OCTOBER TEMPERATURE EXTREMES AND T-H INDEX



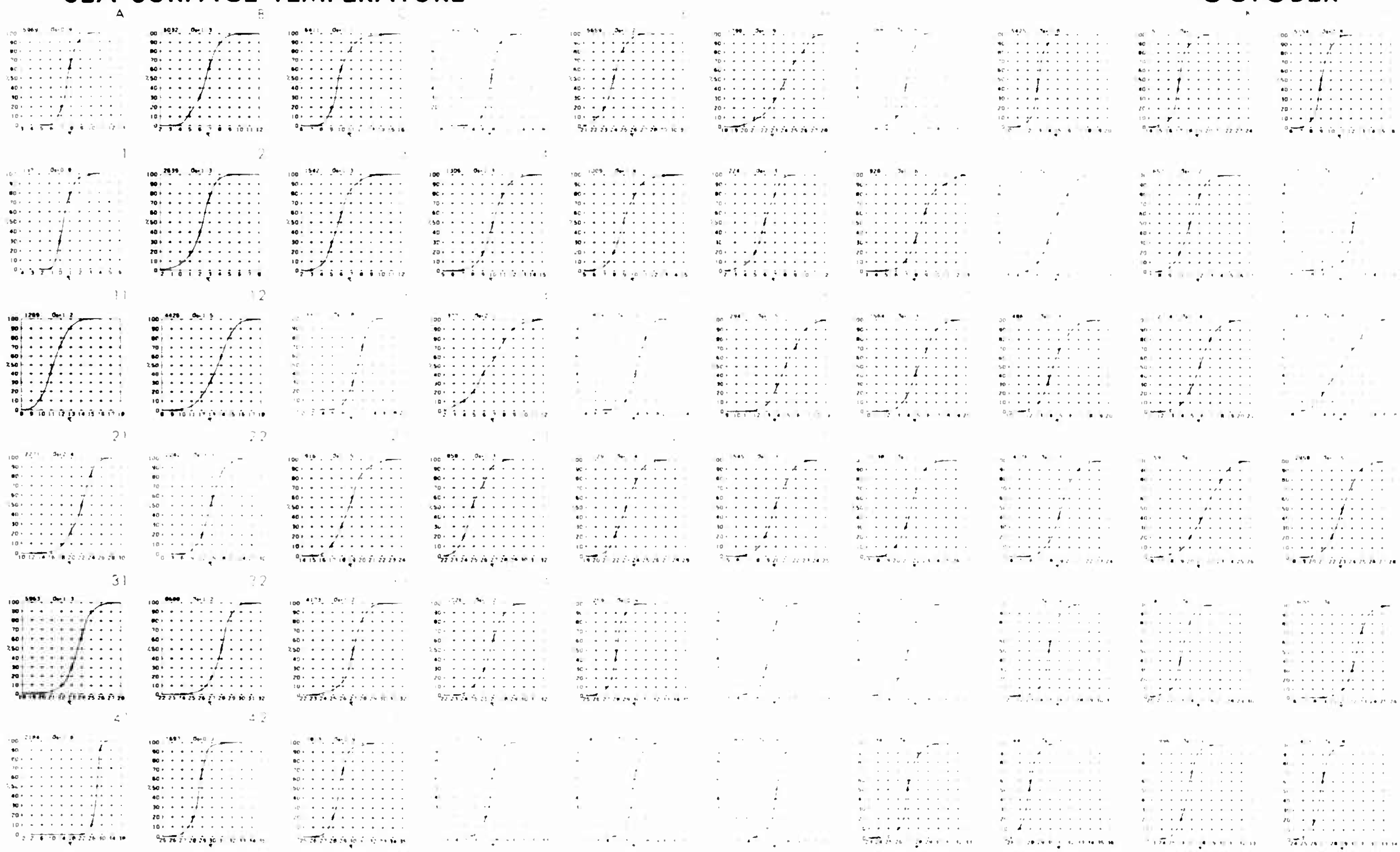
WIND SPEED AND AIR TEMPERATURE

OCTOBER

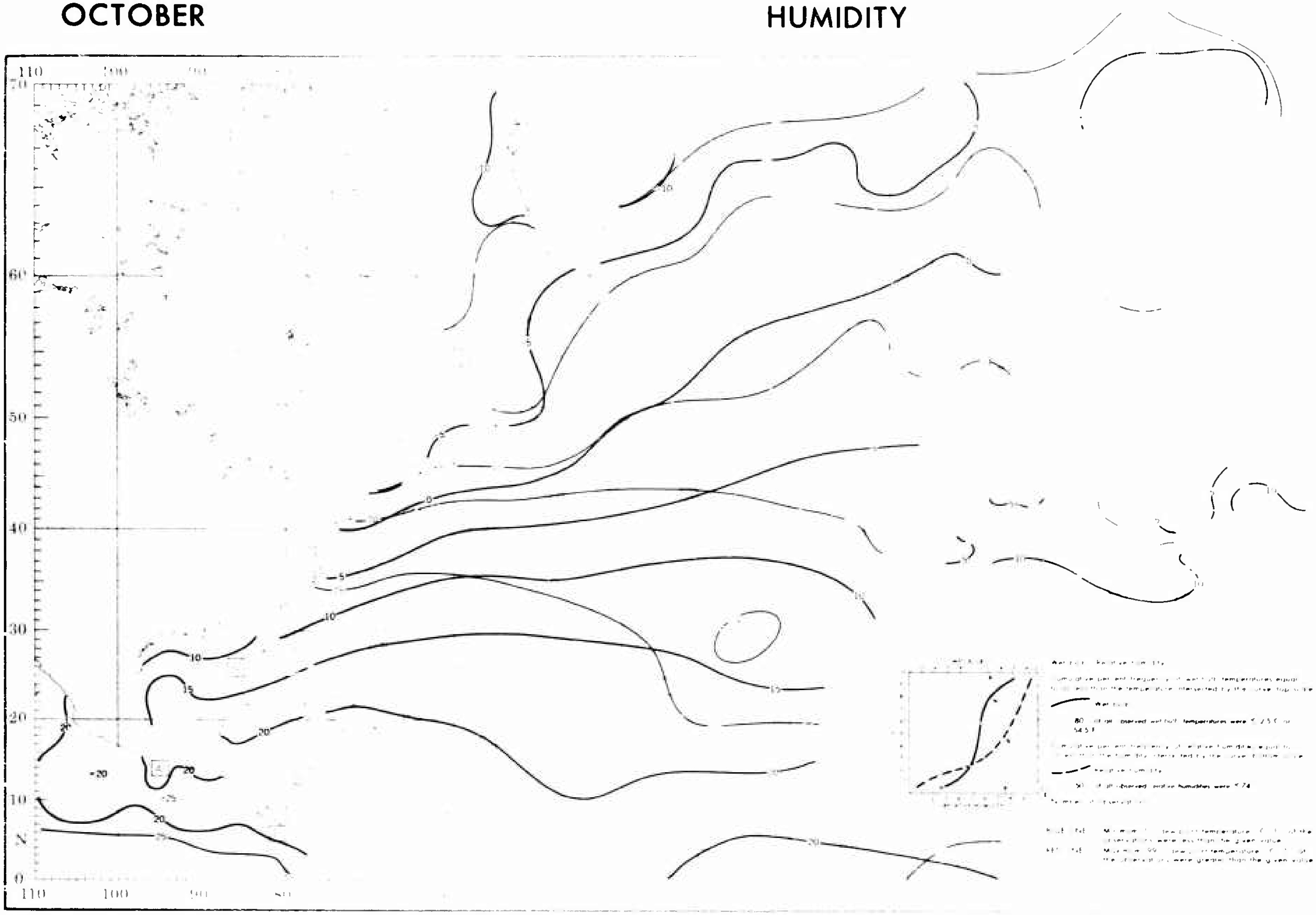
OCTOBER SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE OCTOBER

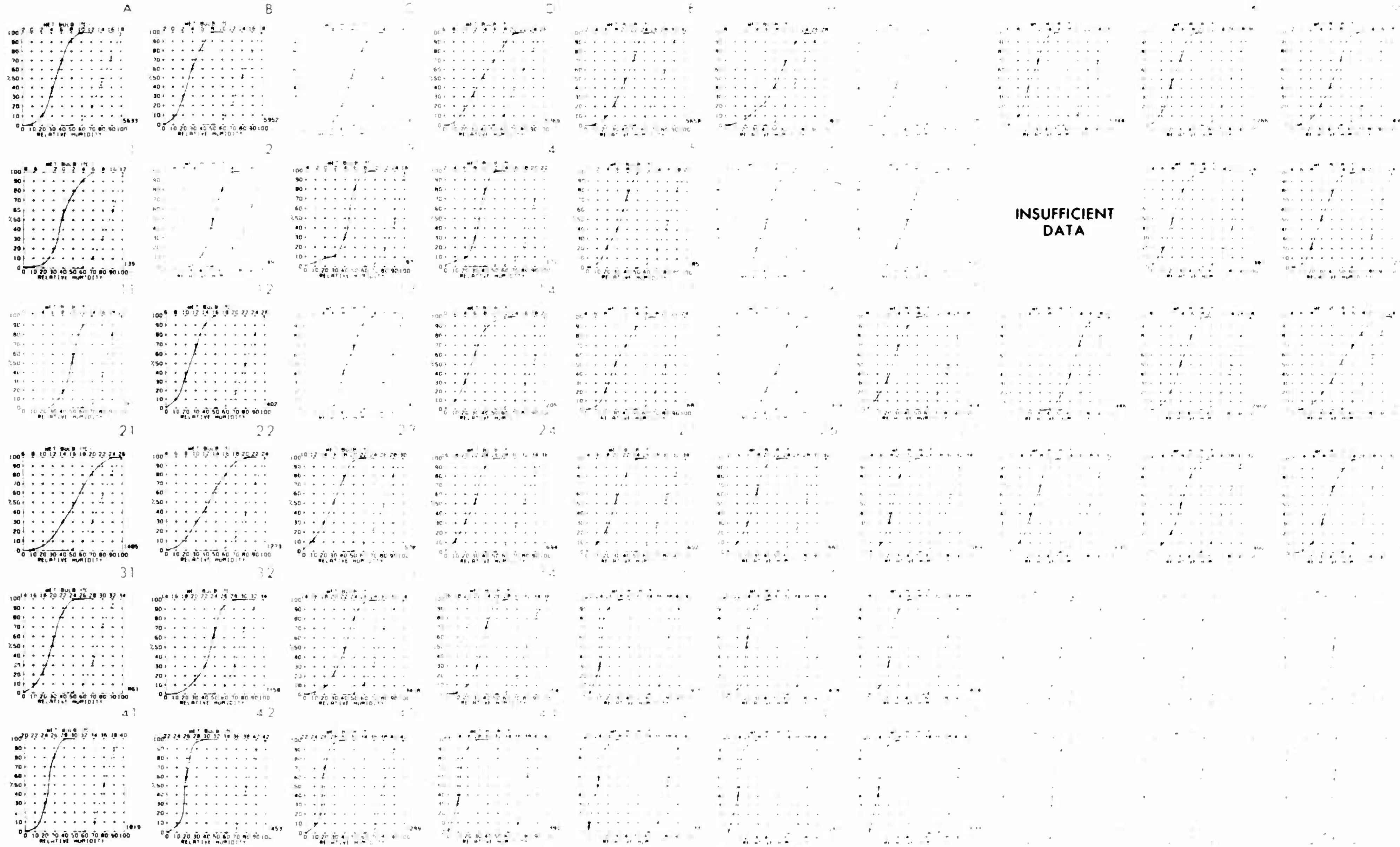


OCTOBER HUMIDITY

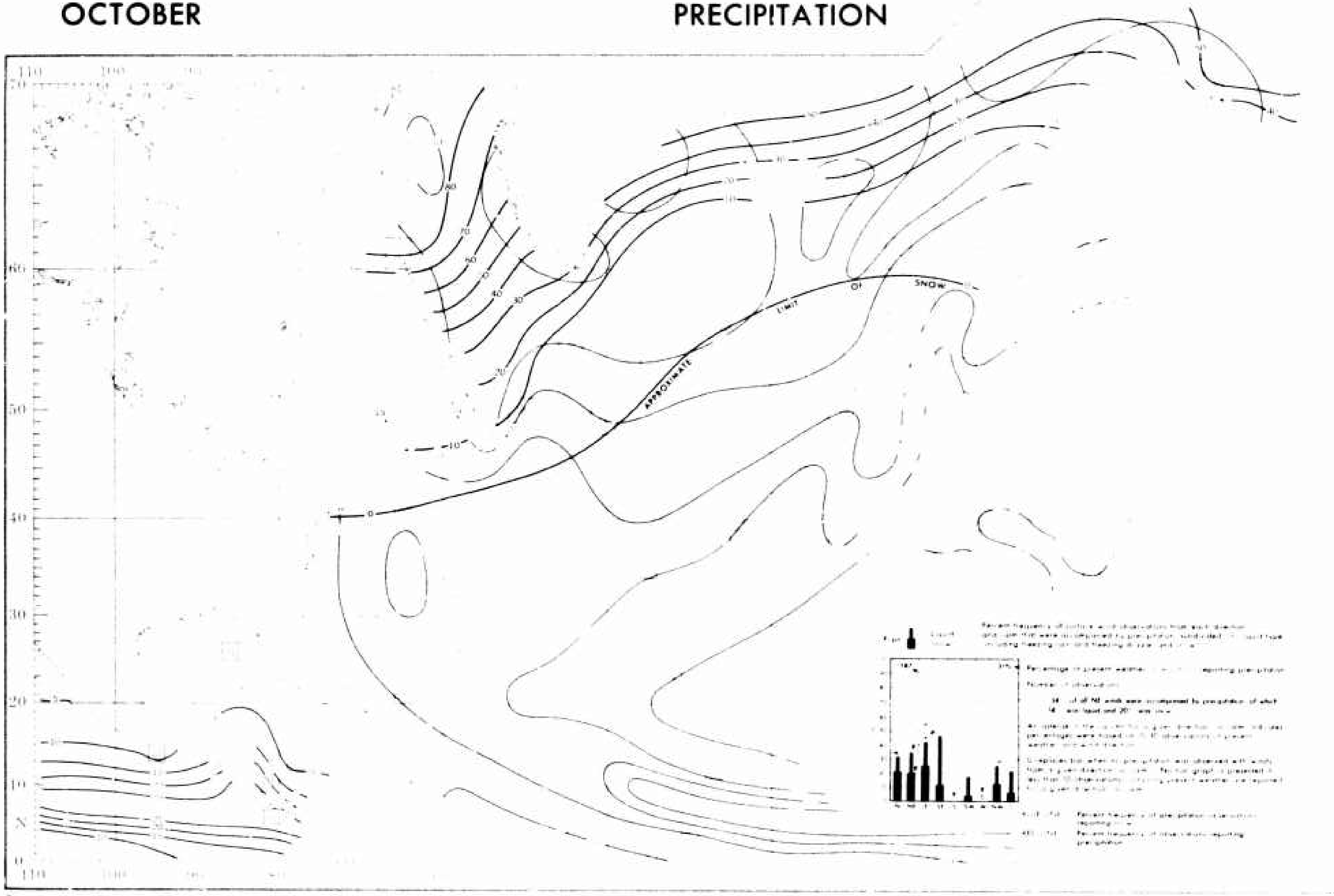


WET BULB AND RELATIVE HUMIDITY

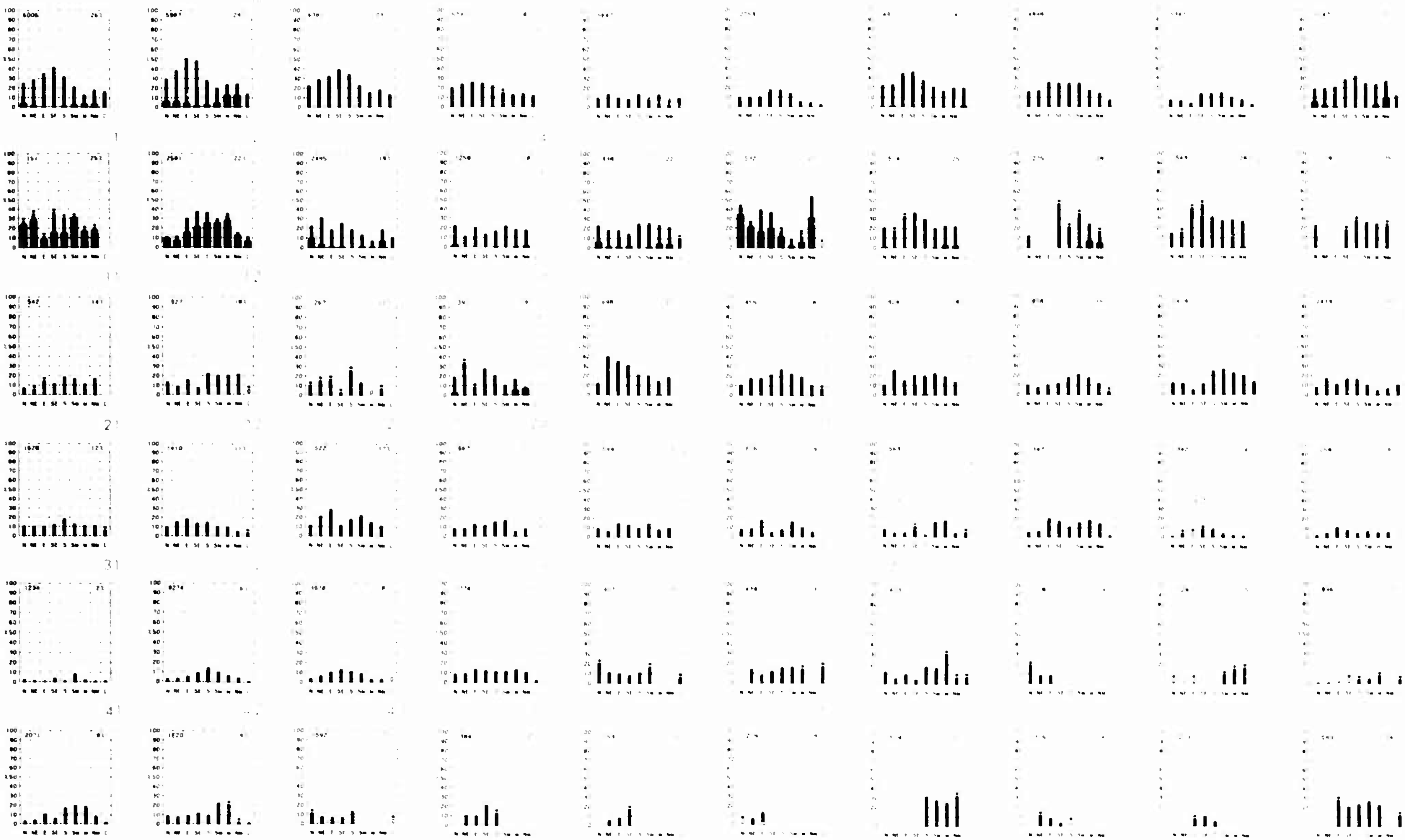
OCTOBER



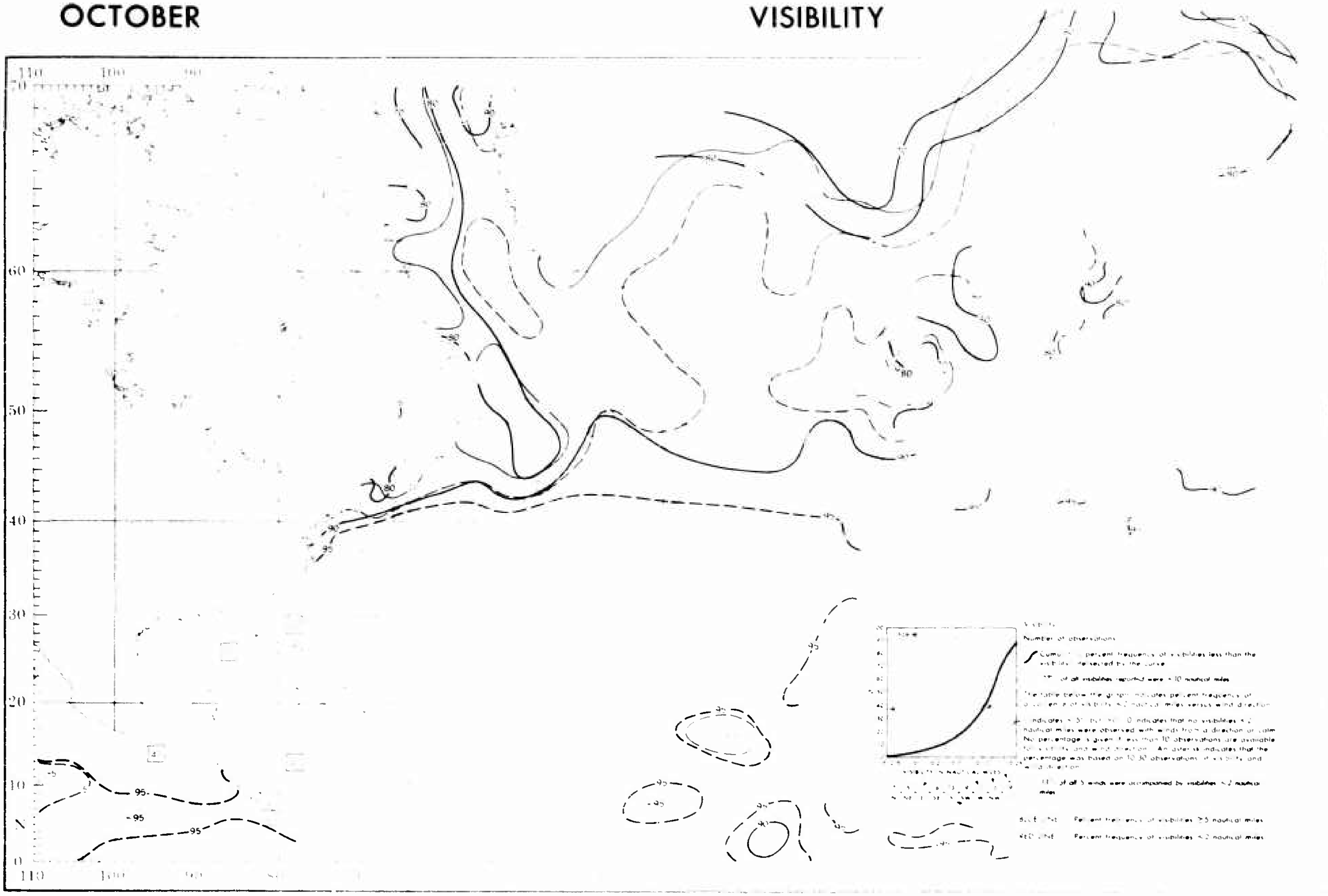
OCTOBER PRECIPITATION



PRECIPITATION OCTOBER

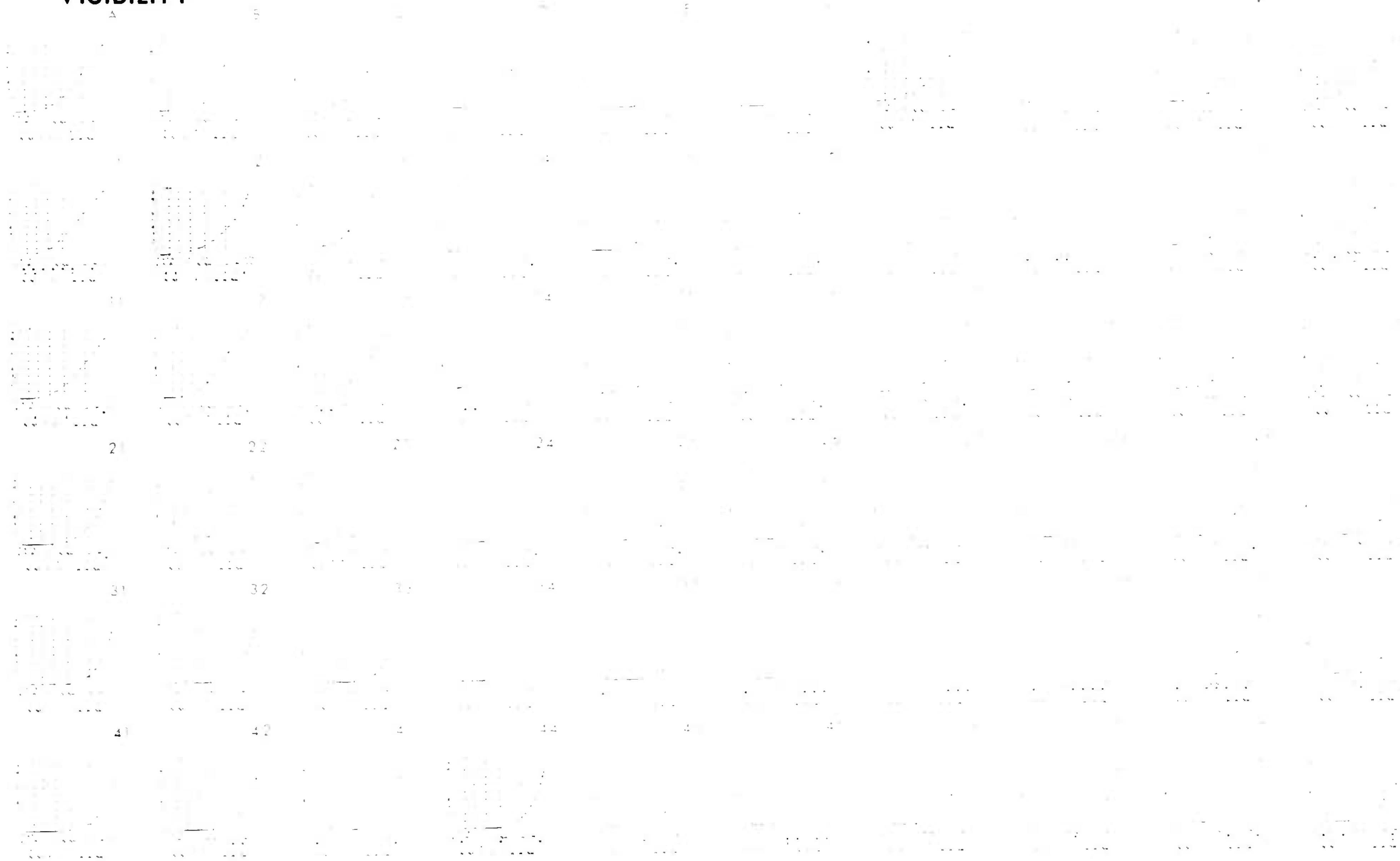


OCTOBER VISIBILITY



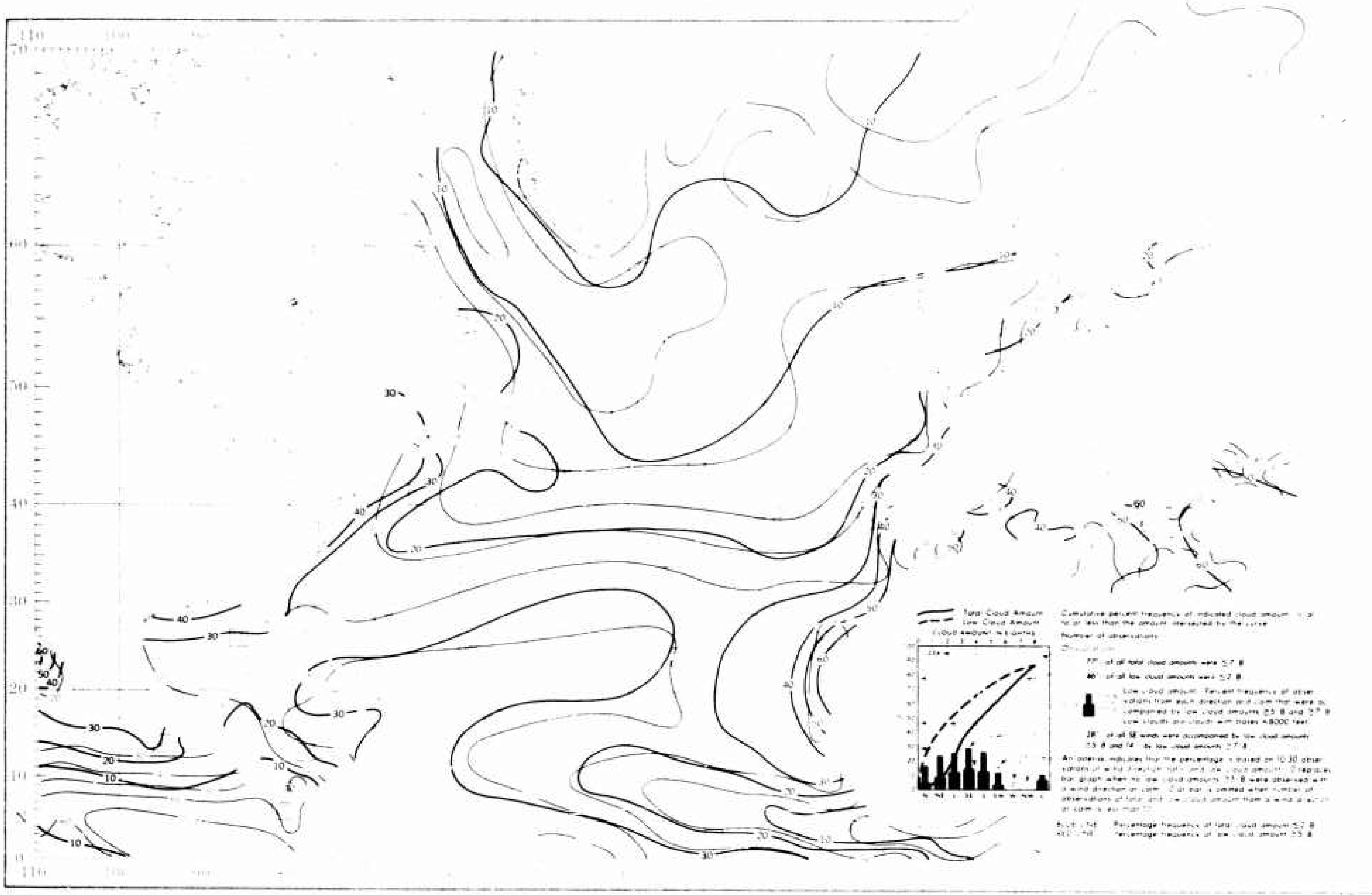
VISIBILITY

OCTOBER



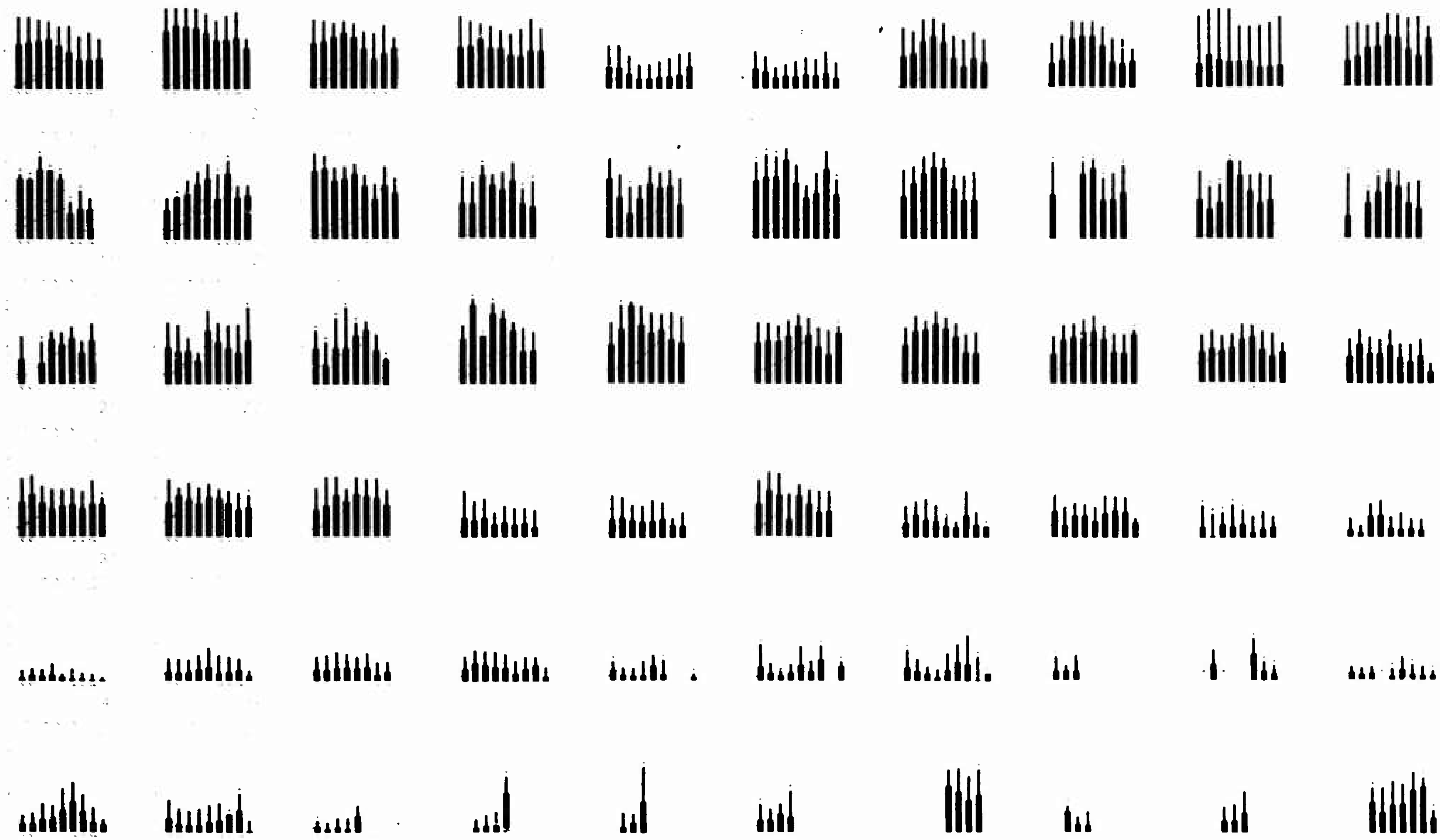
OCTOBER

CLOUD COVER



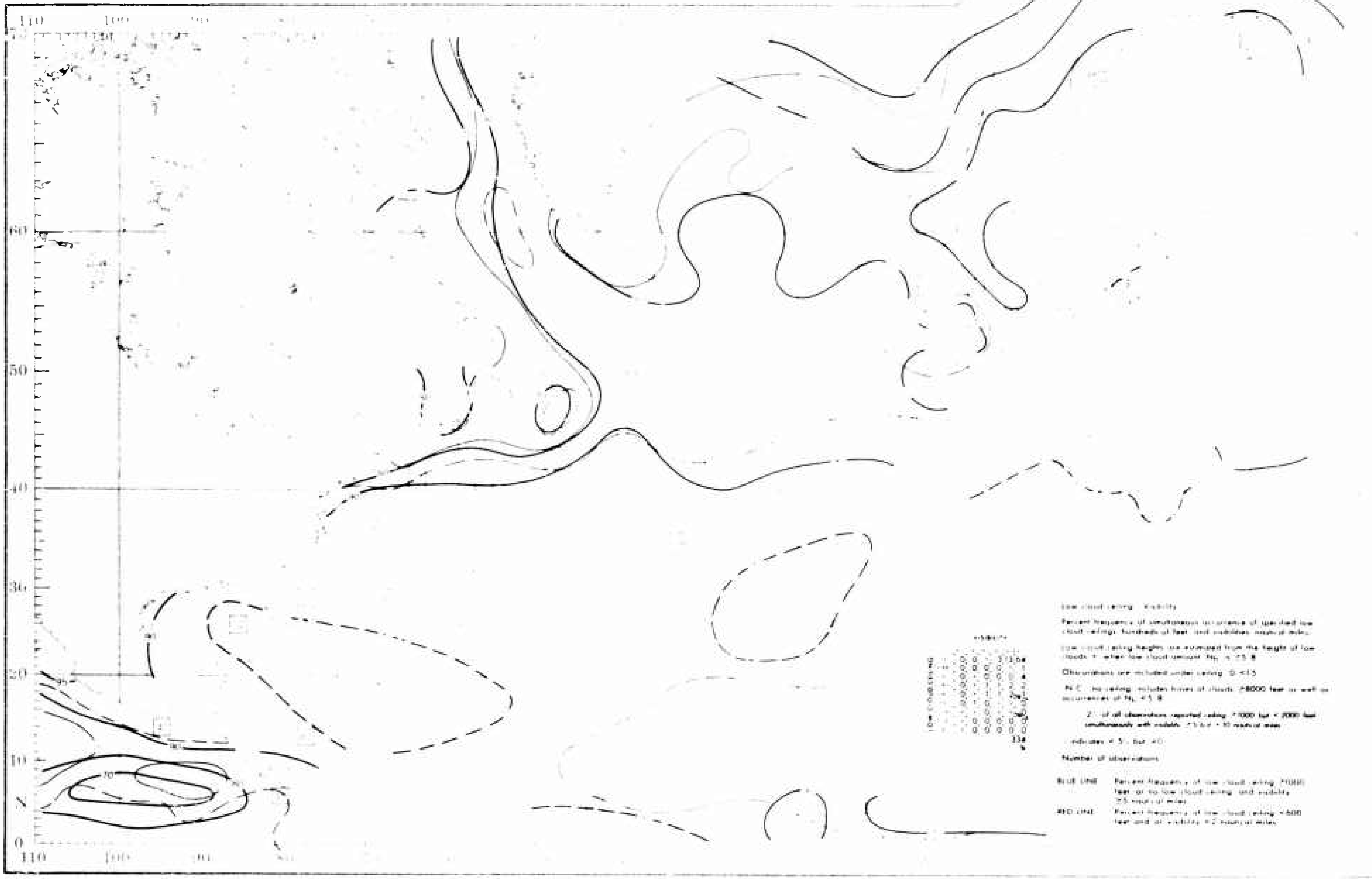
CLOUD COVER

OCTOBER



OCTOBER

CEILING AND VISIBILITY

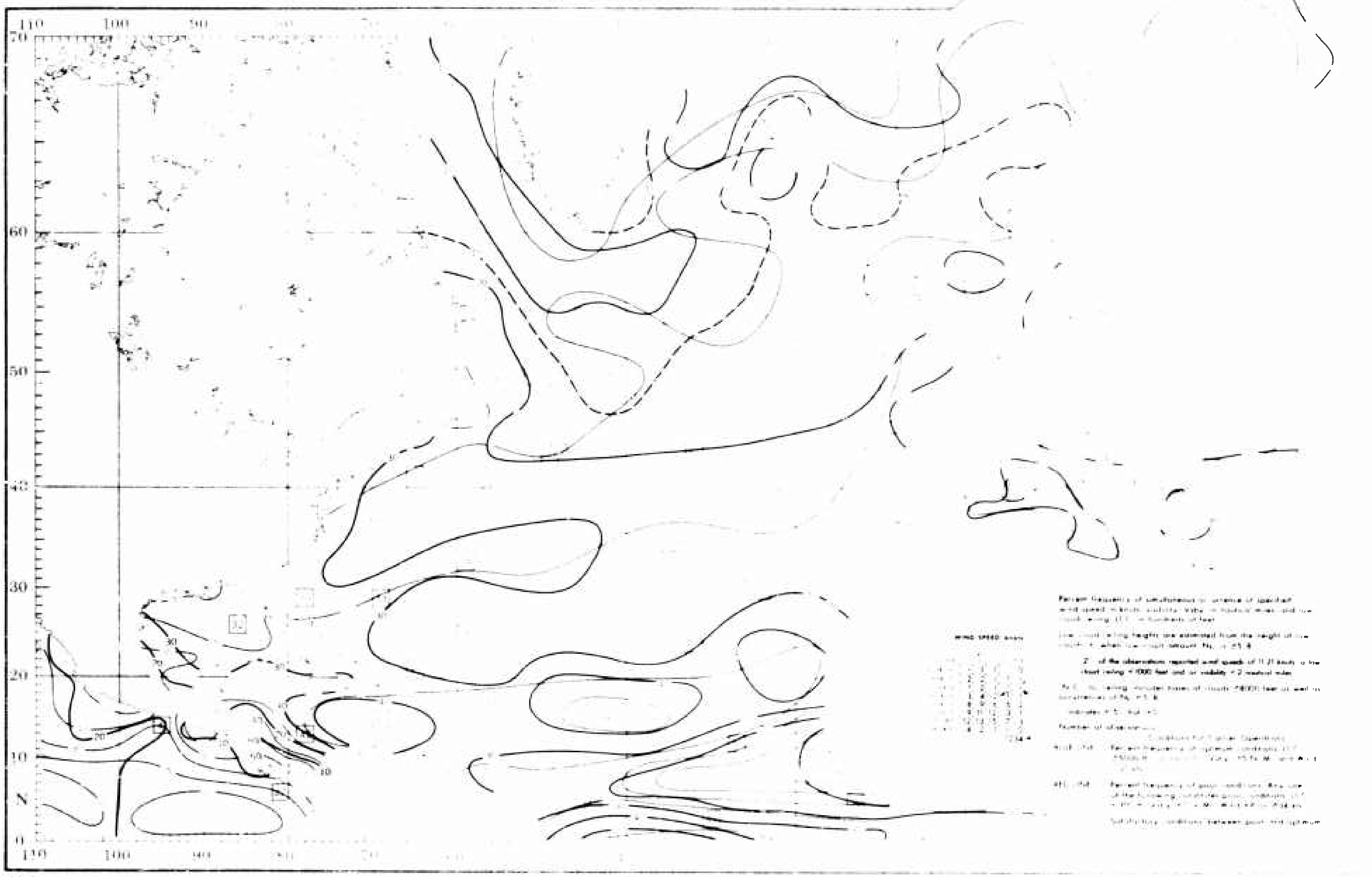


CEILING AND VISIBILITY

OCTOBER

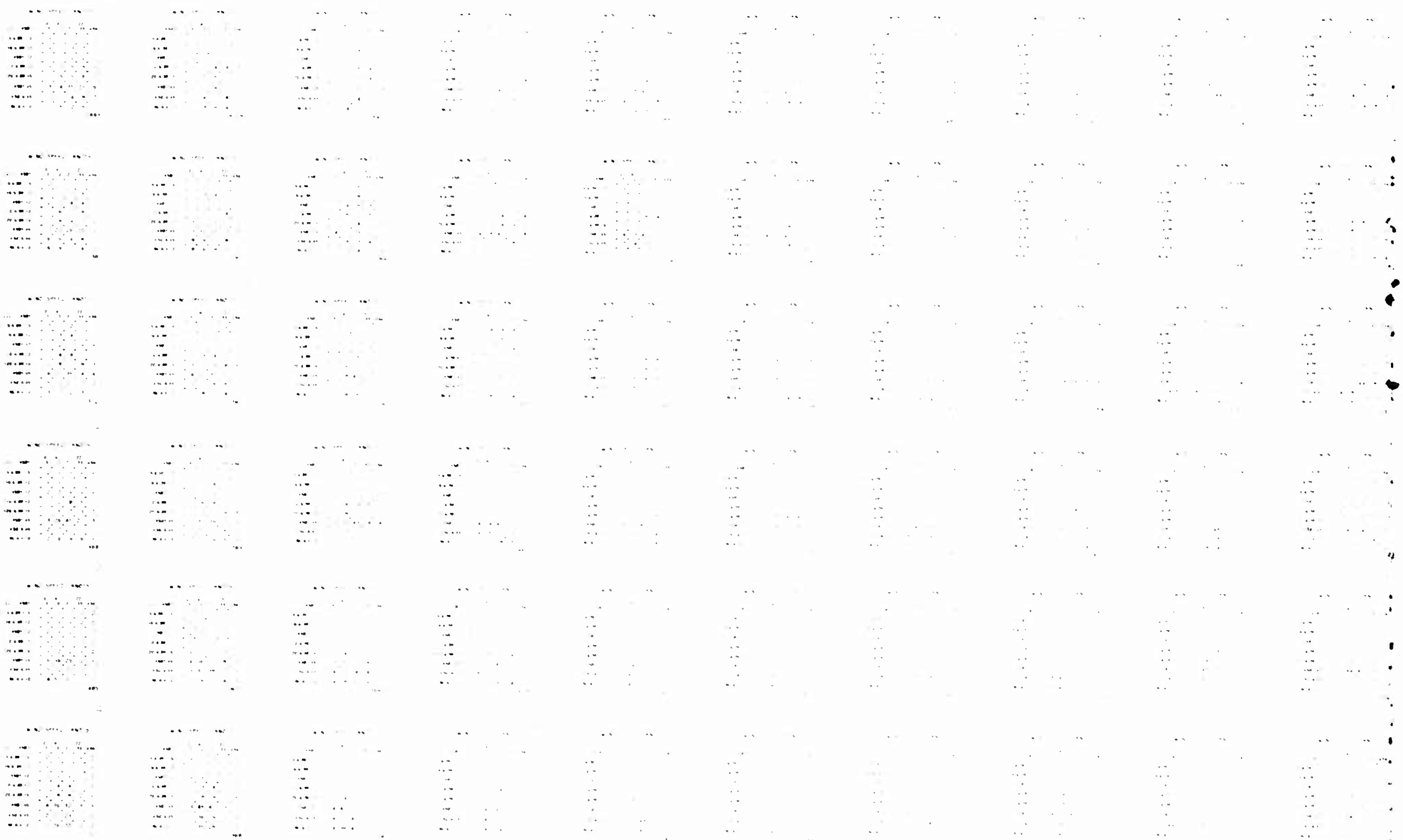
OCTOBER

WIND-VISIBILITY-CLOUDINESS

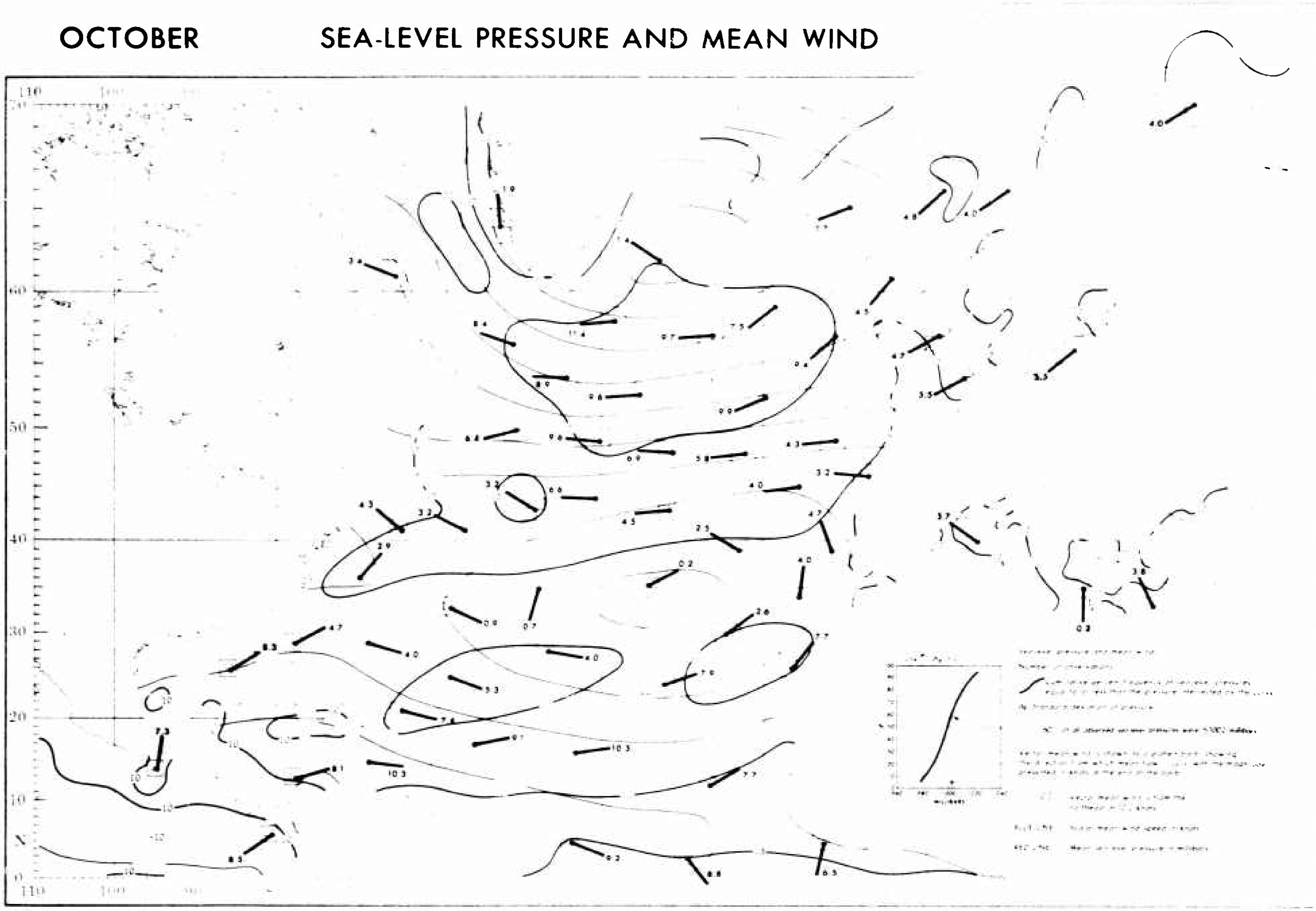


LOW CLOUD CEILING-VISIBILITY-WIND

OCTOBER

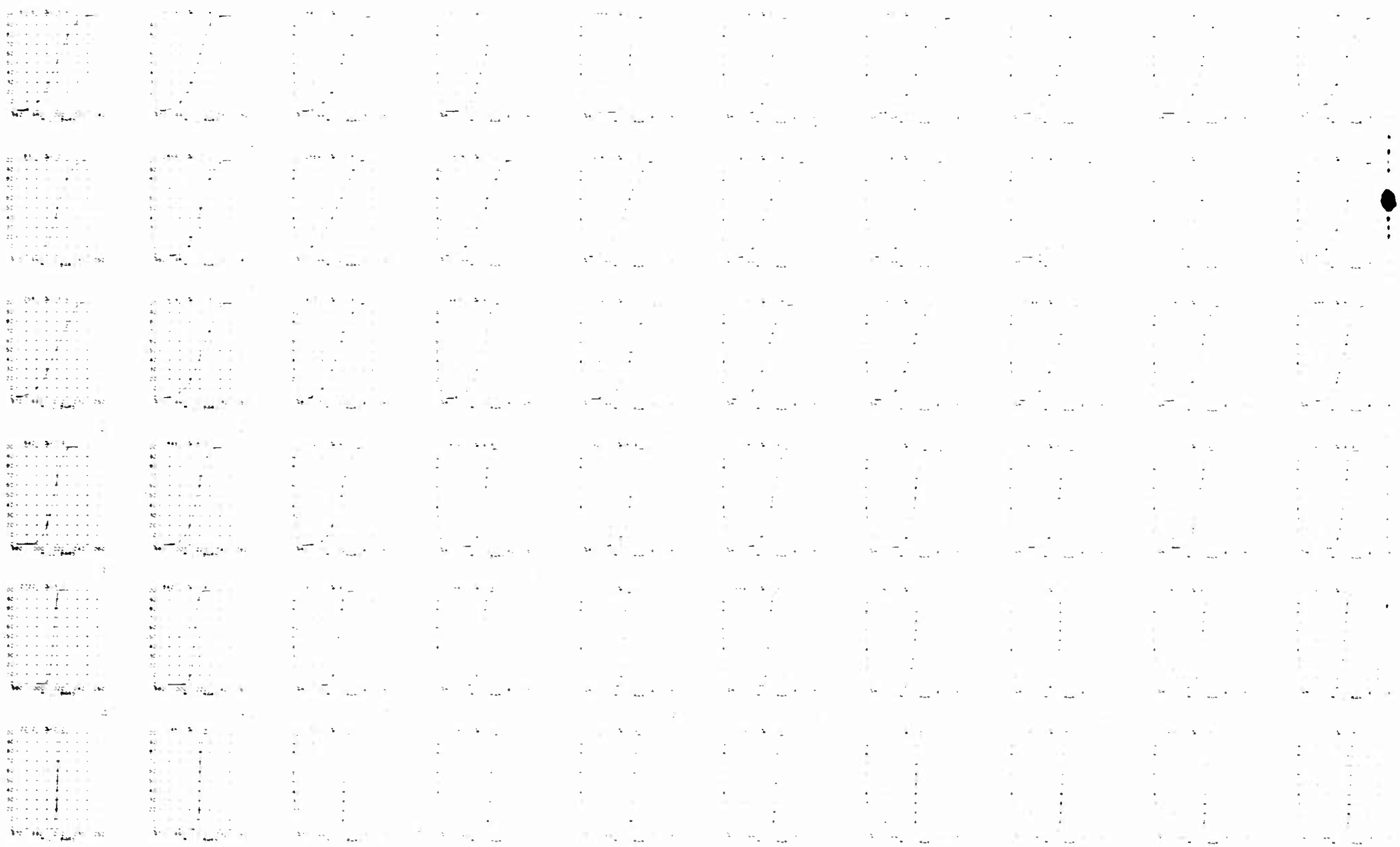


OCTOBER SEA-LEVEL PRESSURE AND MEAN WIND

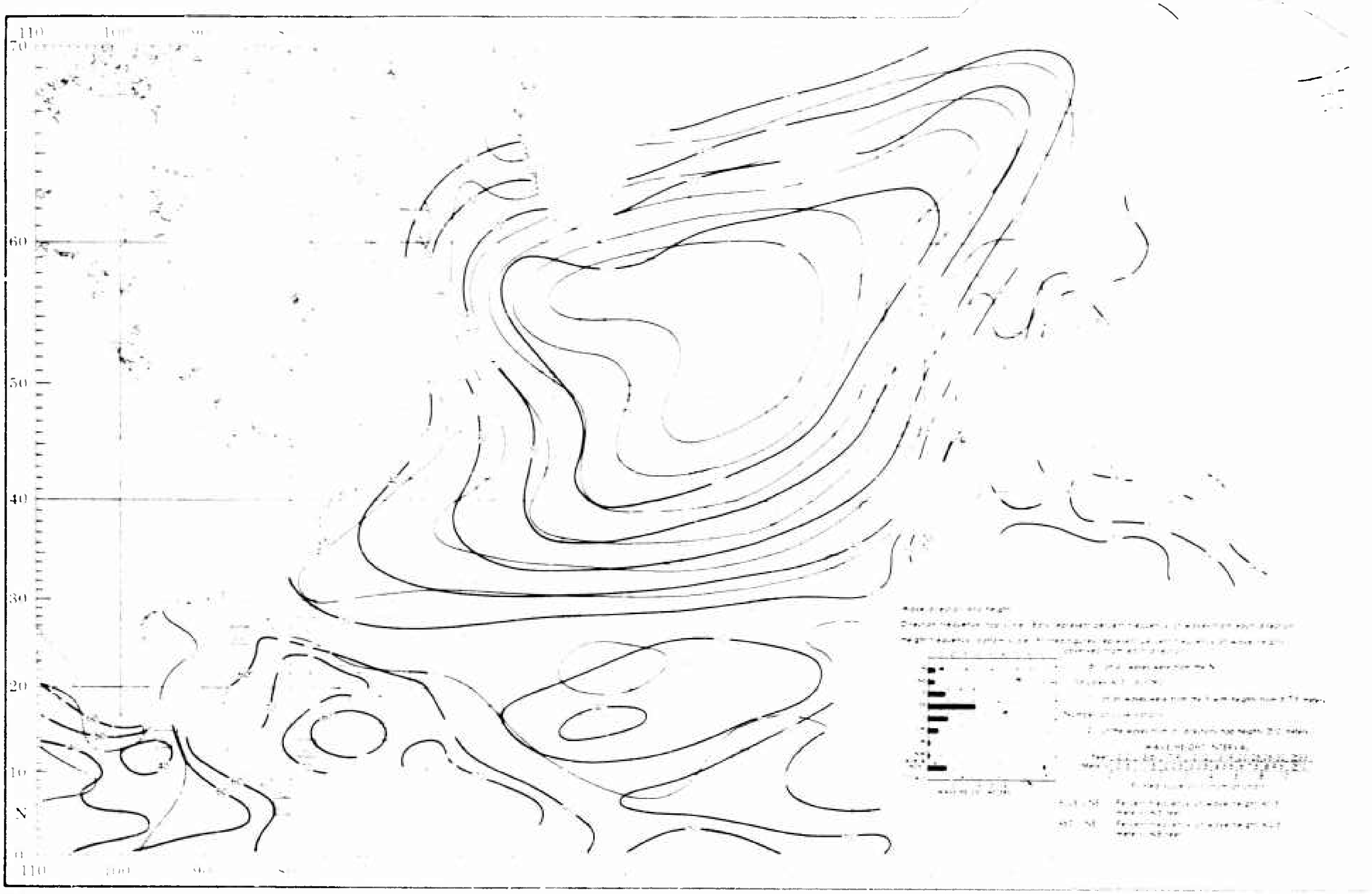


SEA LEVEL PRESSURE

OCTOBER

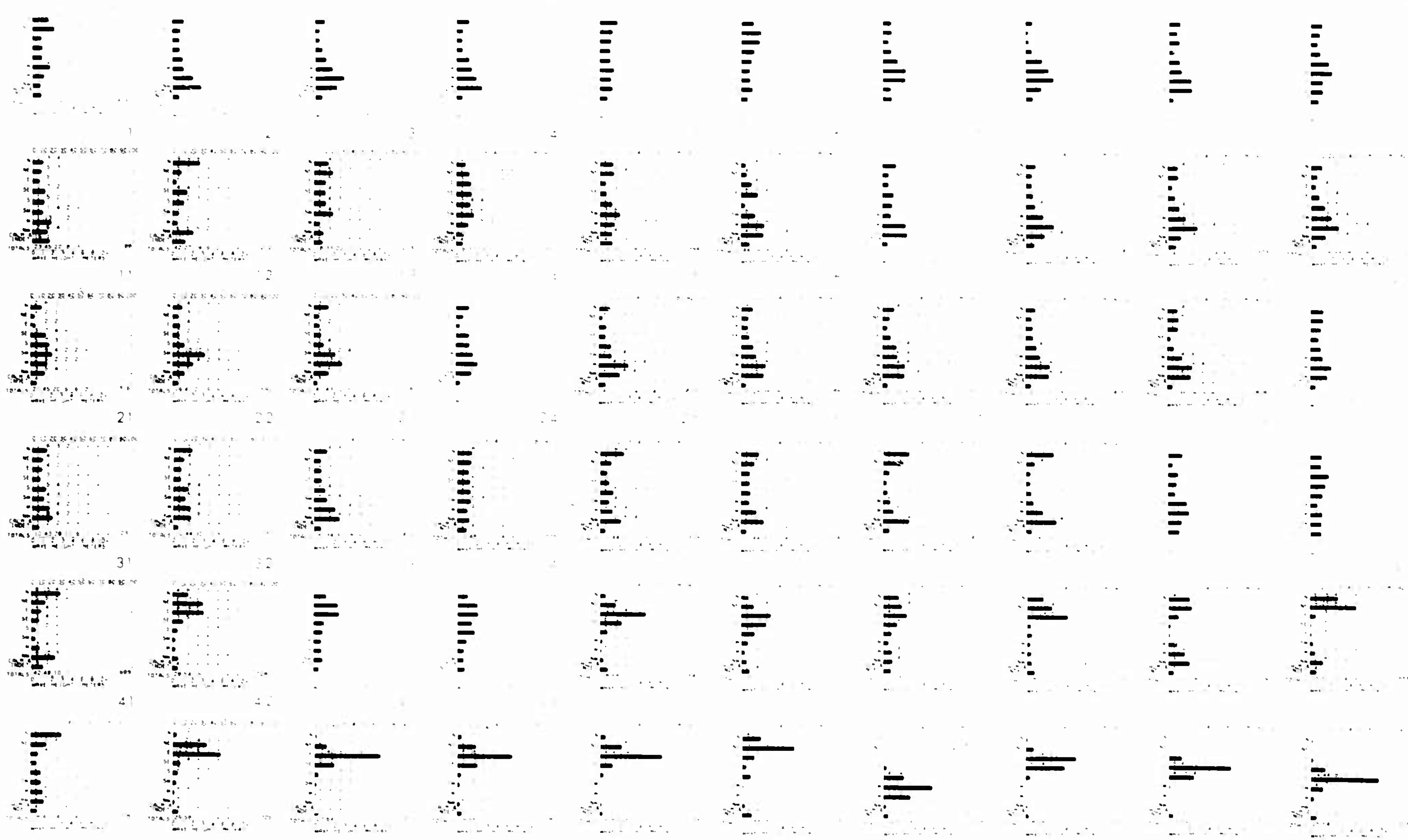


OCTOBER — WAVES (<1.5 AND <2.5 METERS)

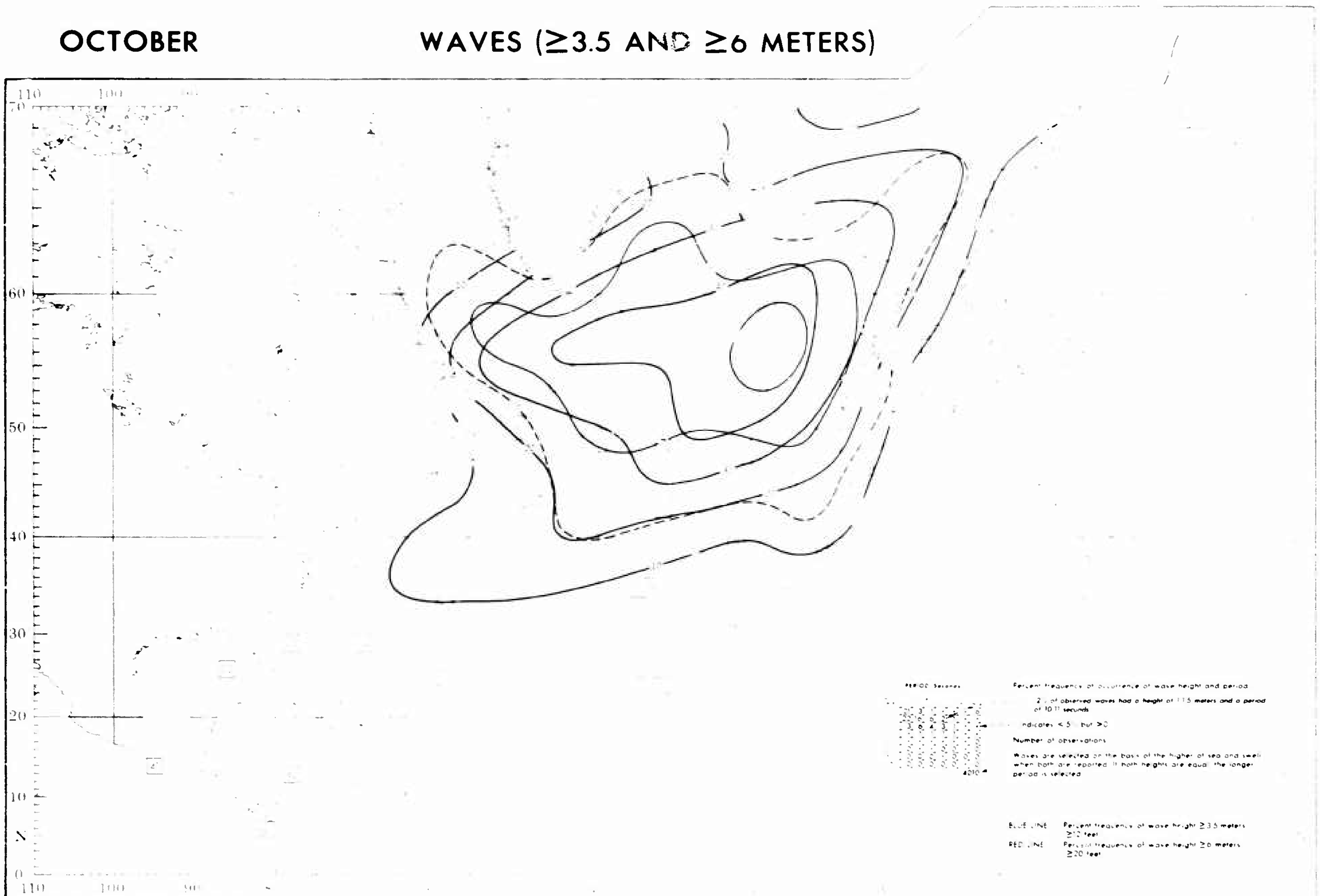


WAVE DIRECTION AND HEIGHT

OCTOBER



OCTOBER WAVES (≥3.5 AND ≥6 METERS)

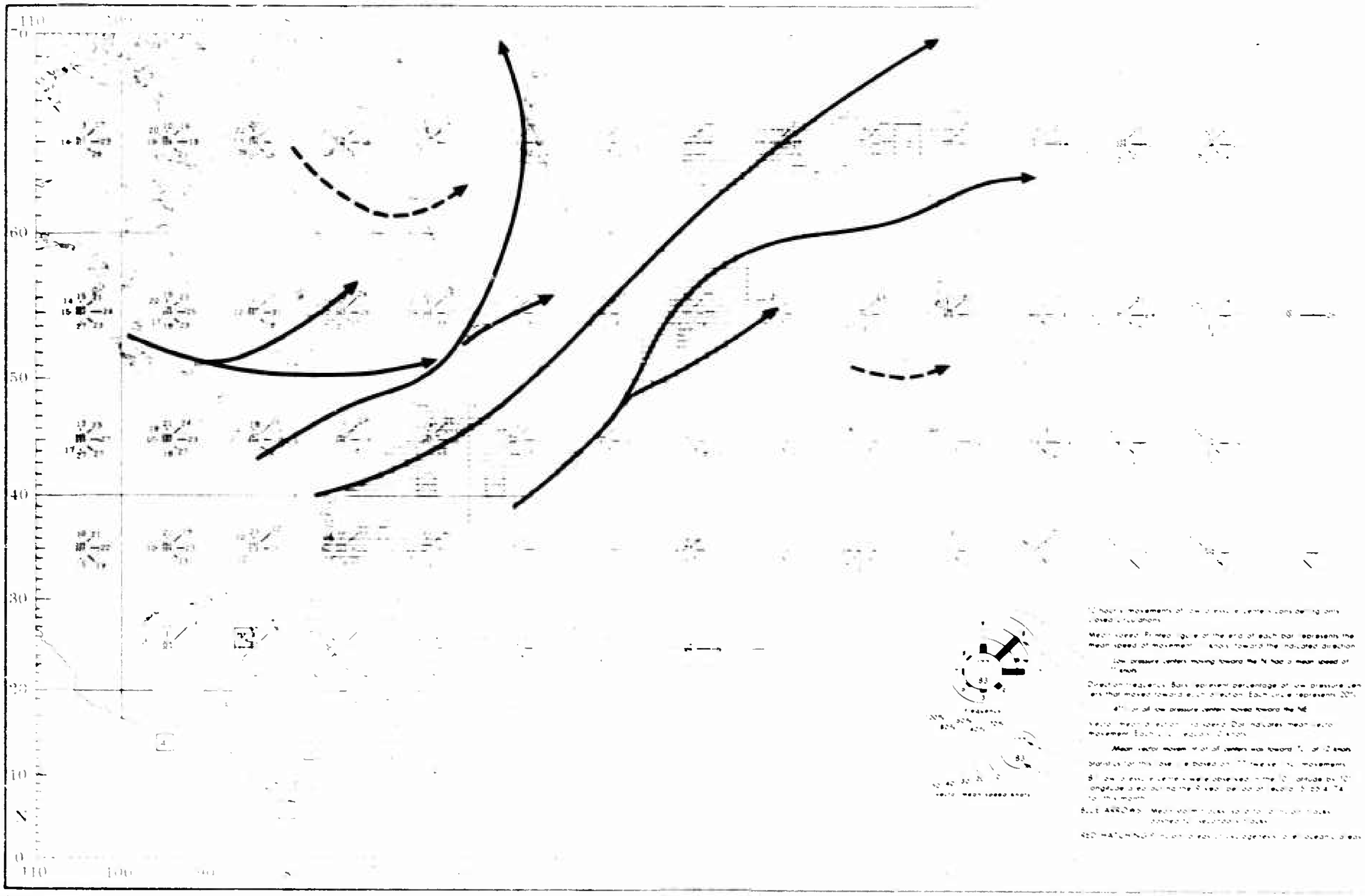


WAVE PERIOD AND HEIGHT

OCTOBER

OCTOBER

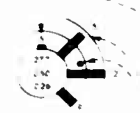
LOW PRESSURE CENTERS



TROPICAL CYCLONE

OCTOBER

12 hourly movements of tropical cyclone centers with tropical storm intensity or greater wind speed estimated ≥34 knots



Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

Centers moving toward the N had a mean speed of 5 knots

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

35% of all tropical cyclones moved toward the NE

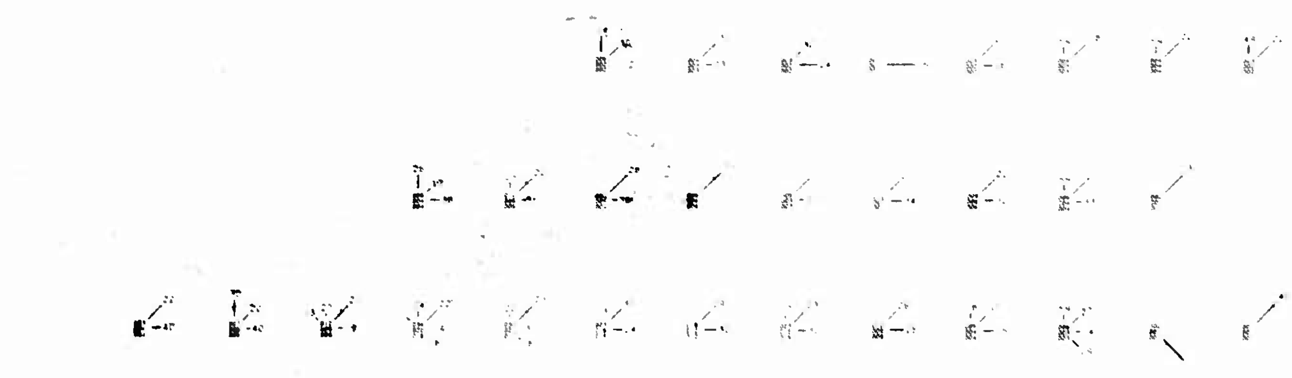
Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

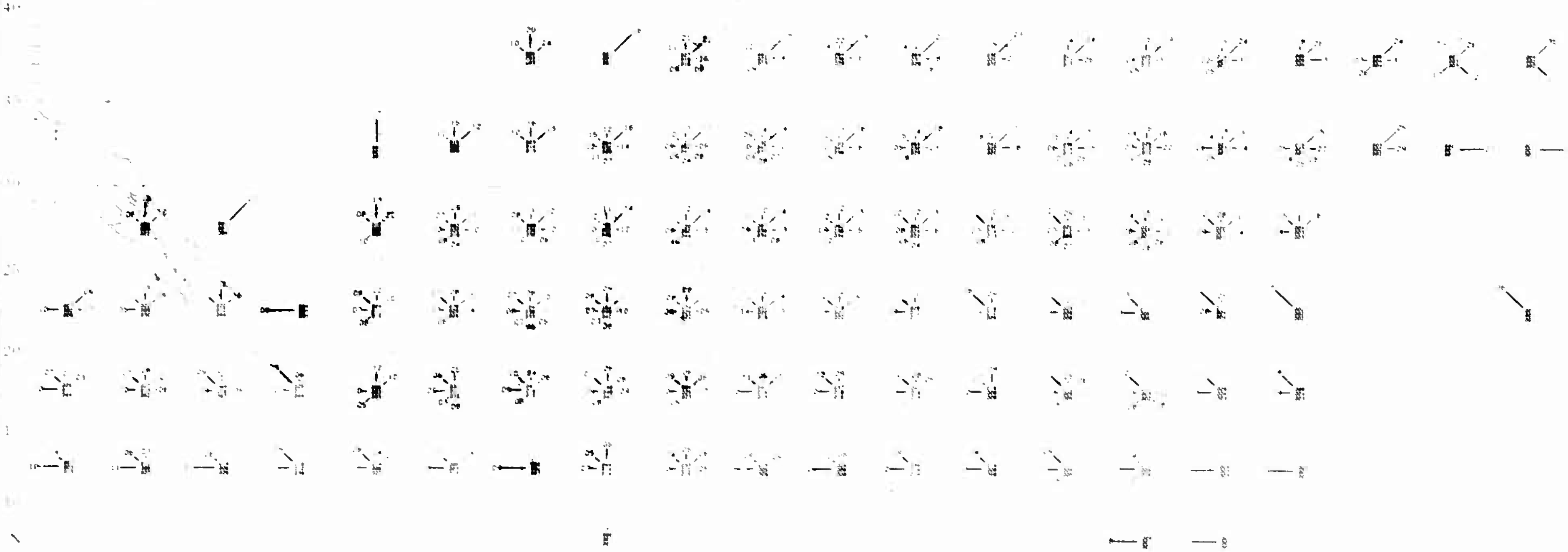
Mean vector movement of all centers was toward 75° at 7 knots

Statistics for this rose are based on 277 twelve hour movements.

50 individual storms were observed in the 5° X 5° area during the period of record

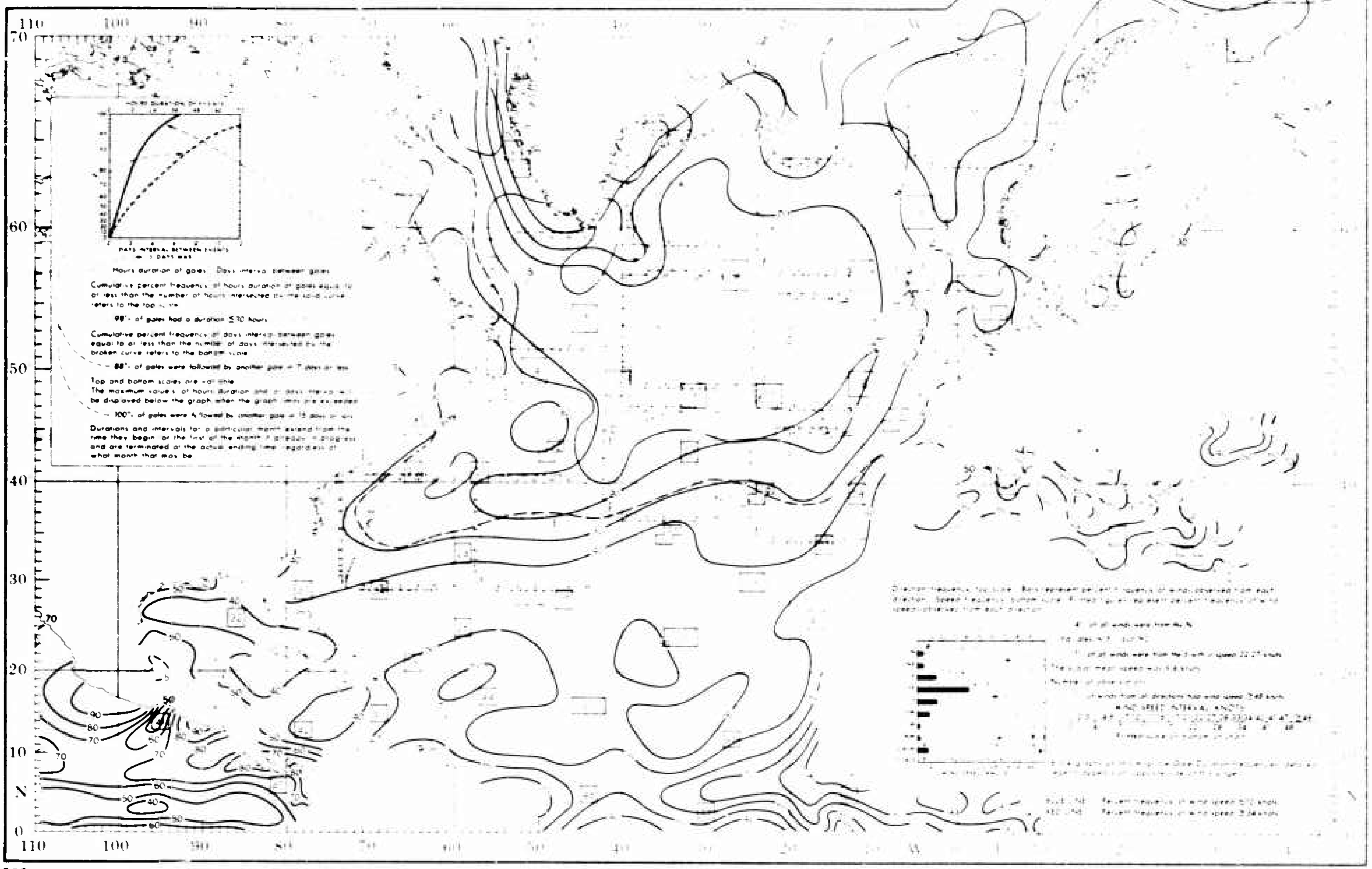
Probability of having at least one tropical cyclone in this area in any given year for this month is 26%





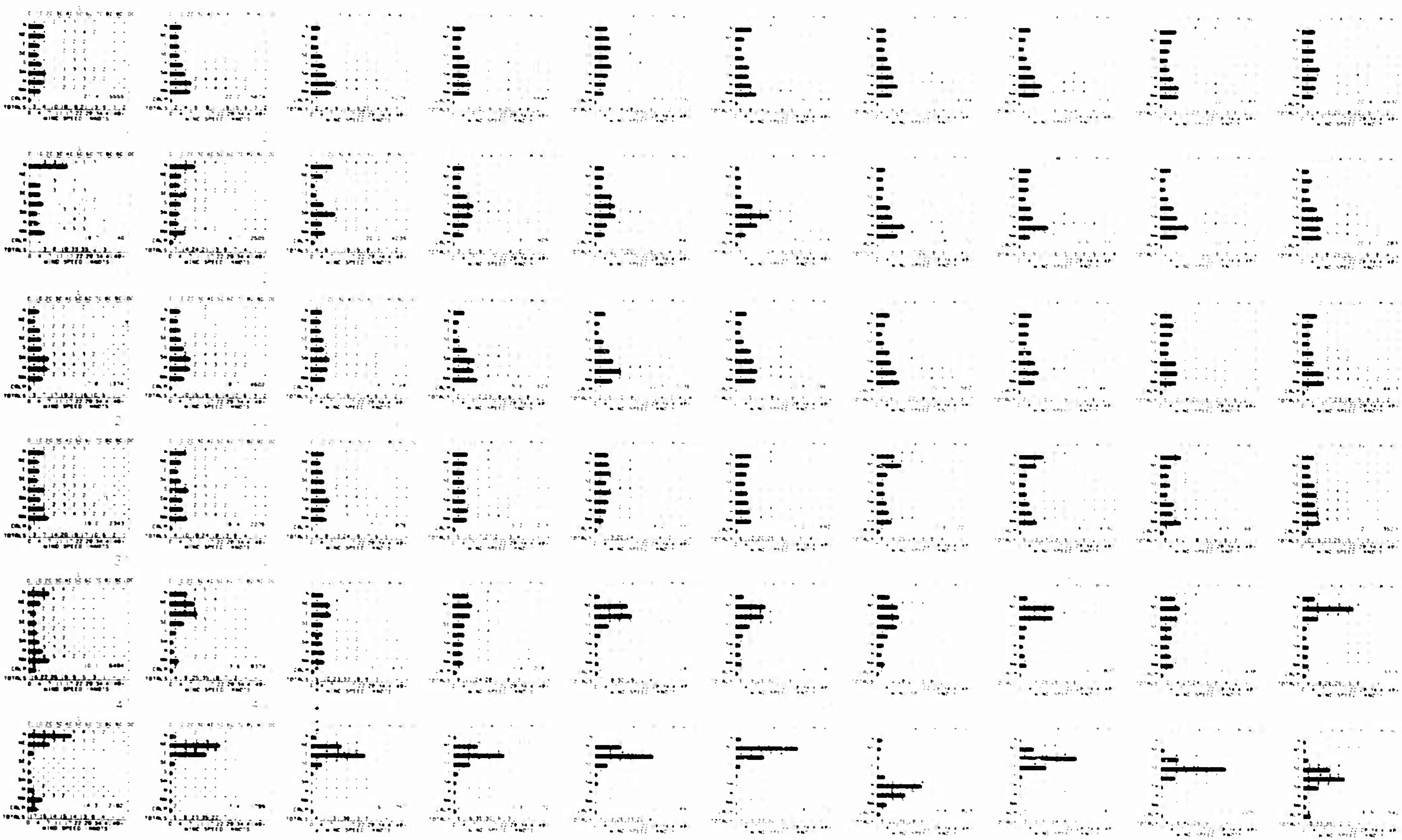
NOVEMBER

SURFACE WINDS

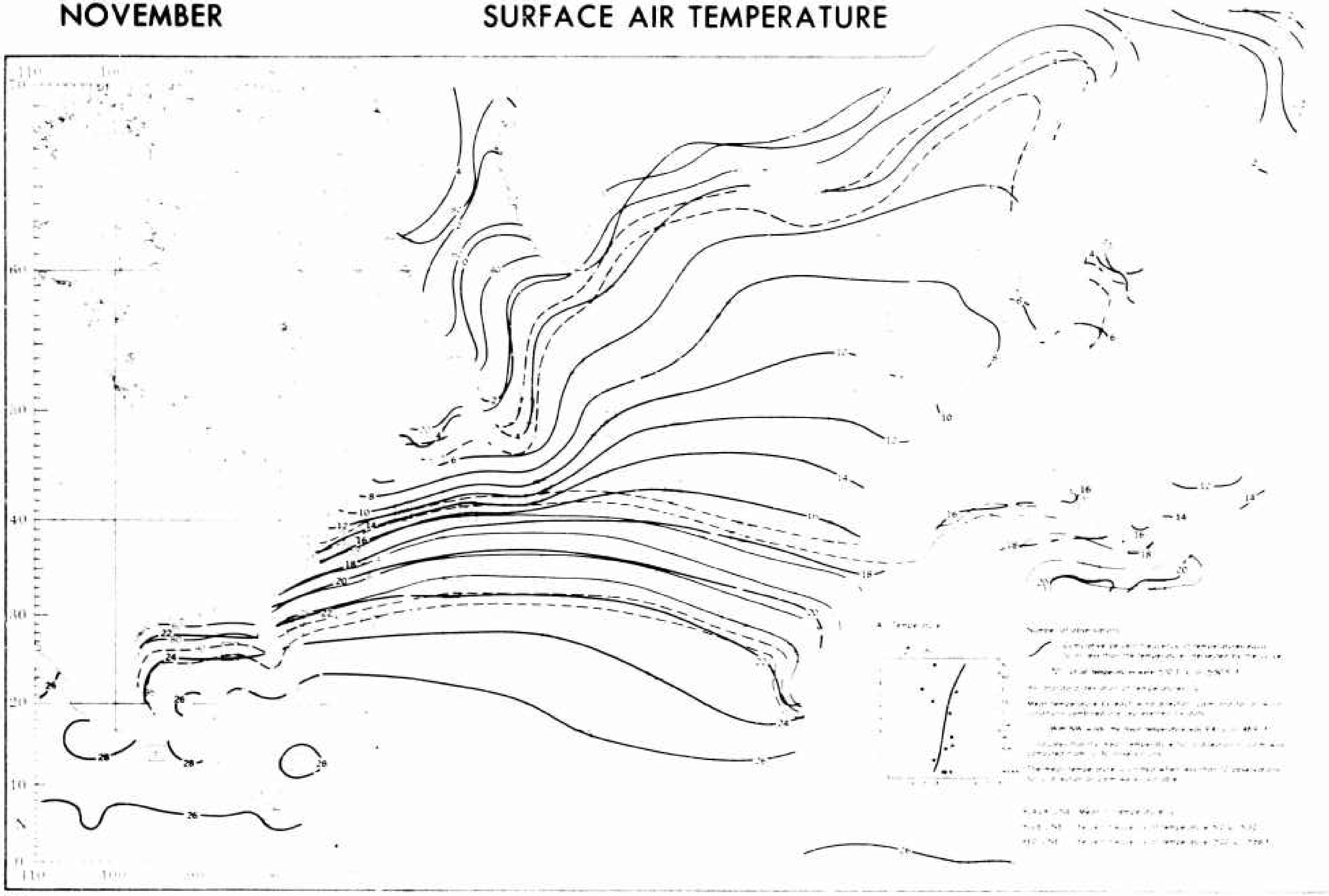


WIND DIRECTION AND SPEED

NOVEMBER

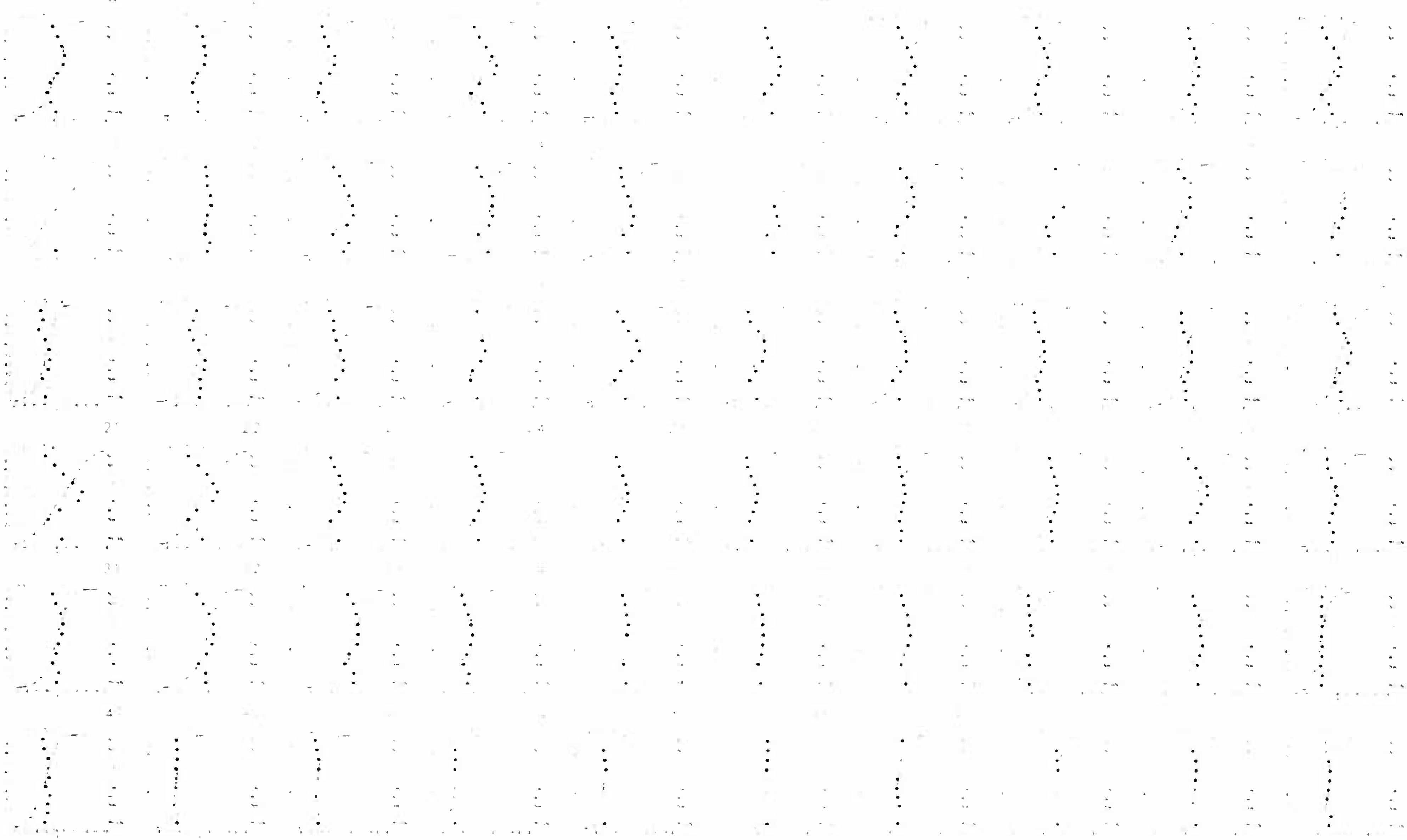


NOVEMBER SURFACE AIR TEMPERATURE

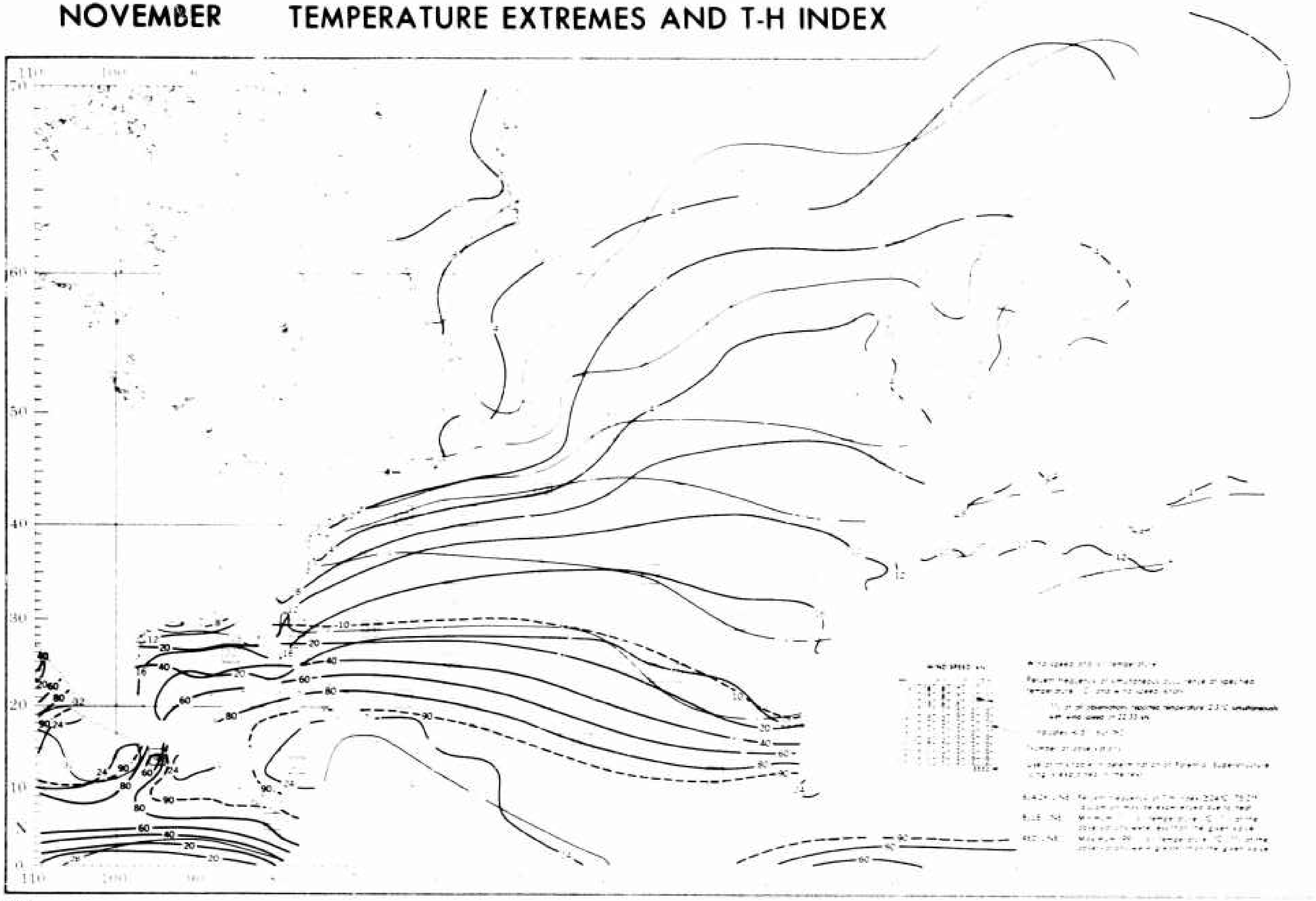


SURFACE AIR TEMPERATURE

NOVEMBER



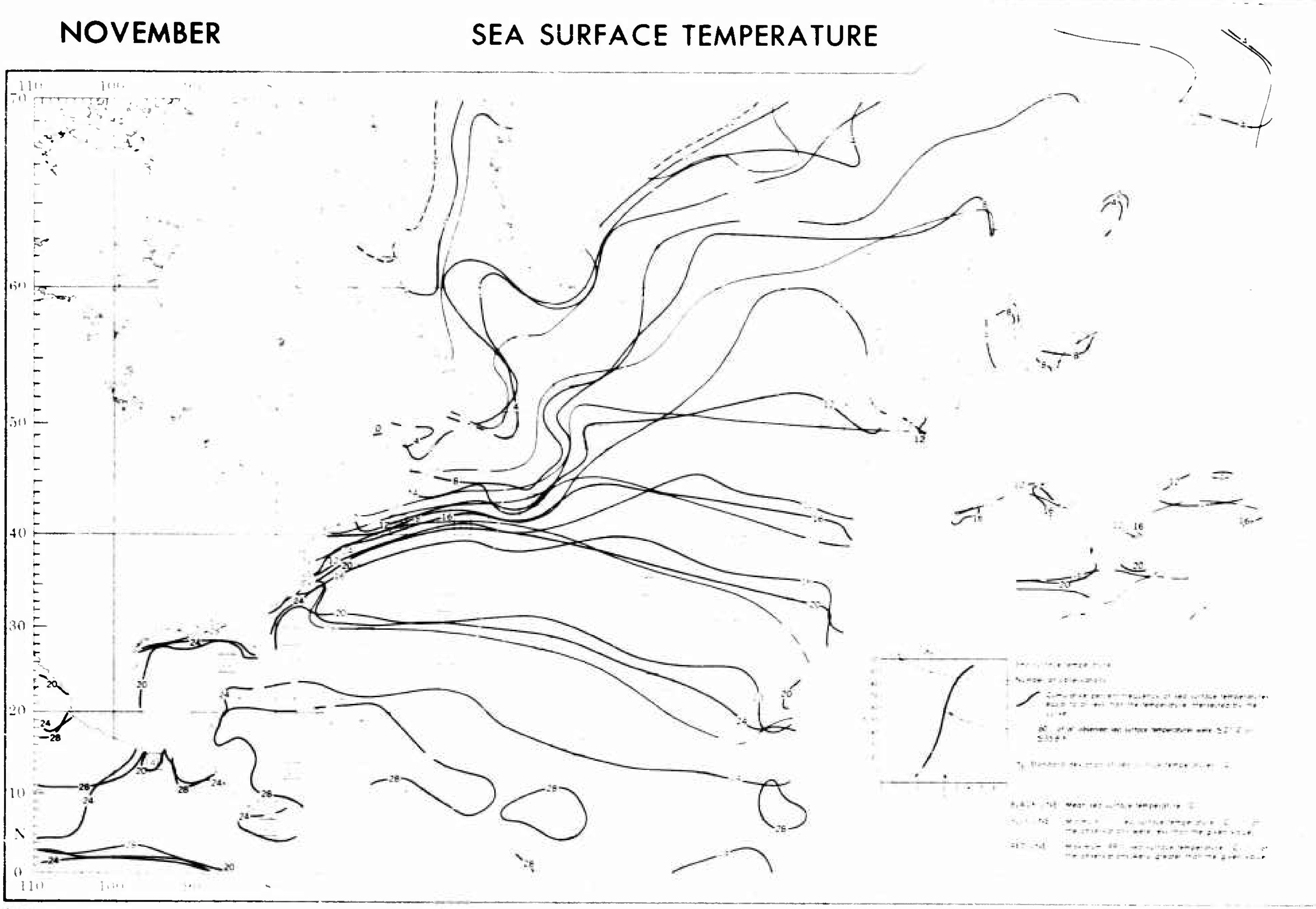
NOVEMBER TEMPERATURE EXTREMES AND T-H INDEX



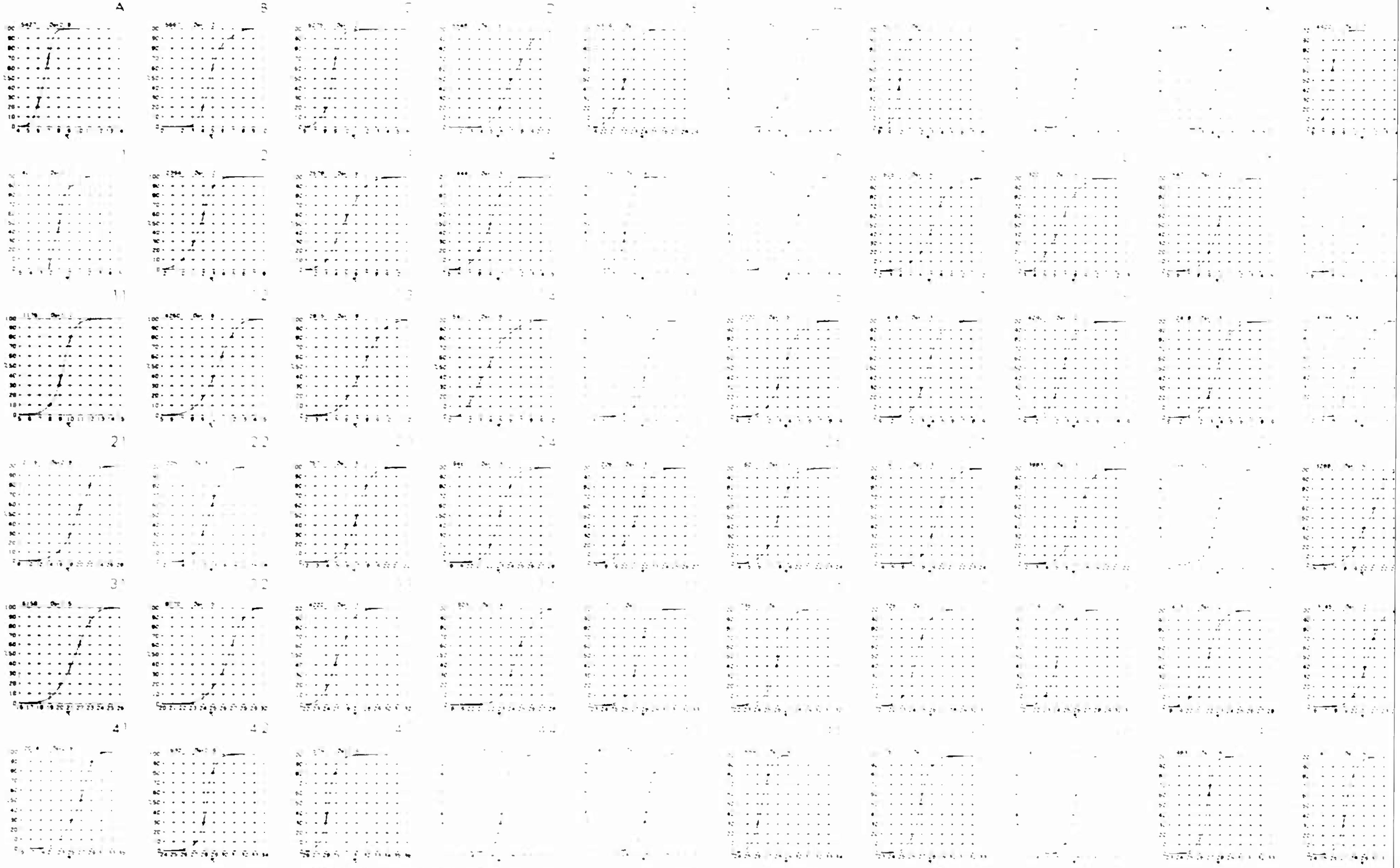
WIND SPEED AND AIR TEMPERATURE

NOVEMBER

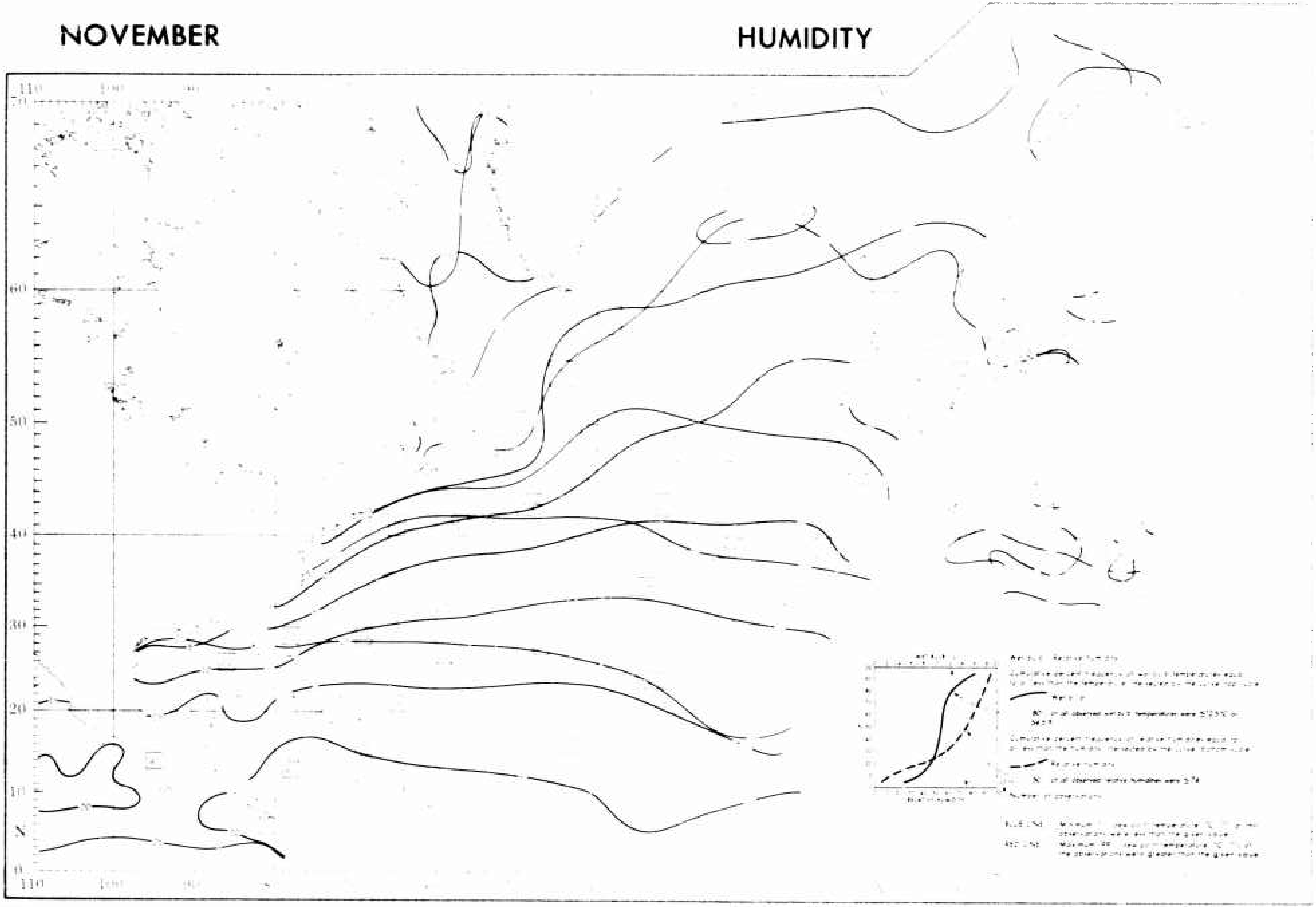
NOVEMBER SEA SURFACE TEMPERATURE



SEA SURFACE TEMPERATURE NOVEMBER

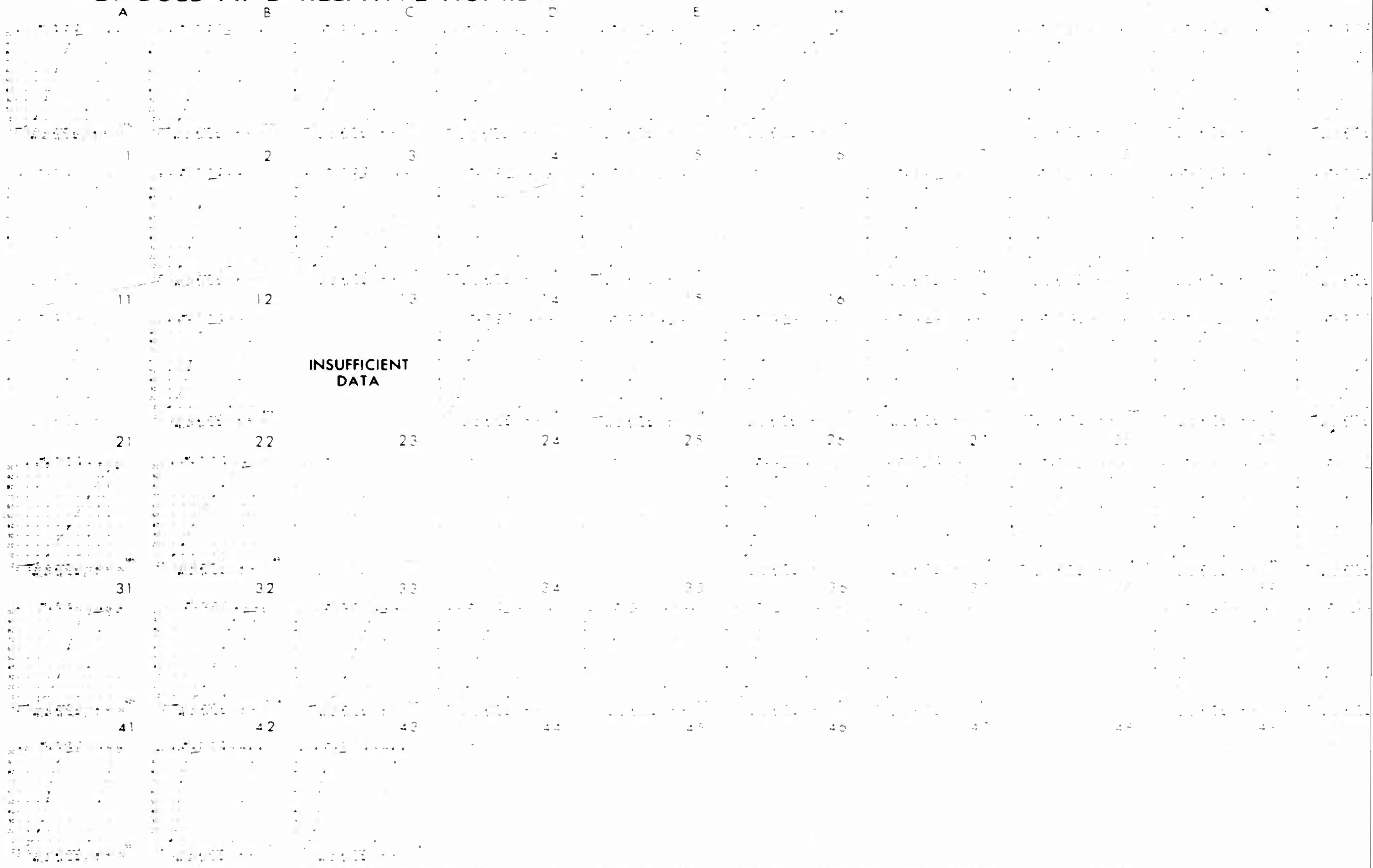


NOVEMBER HUMIDITY

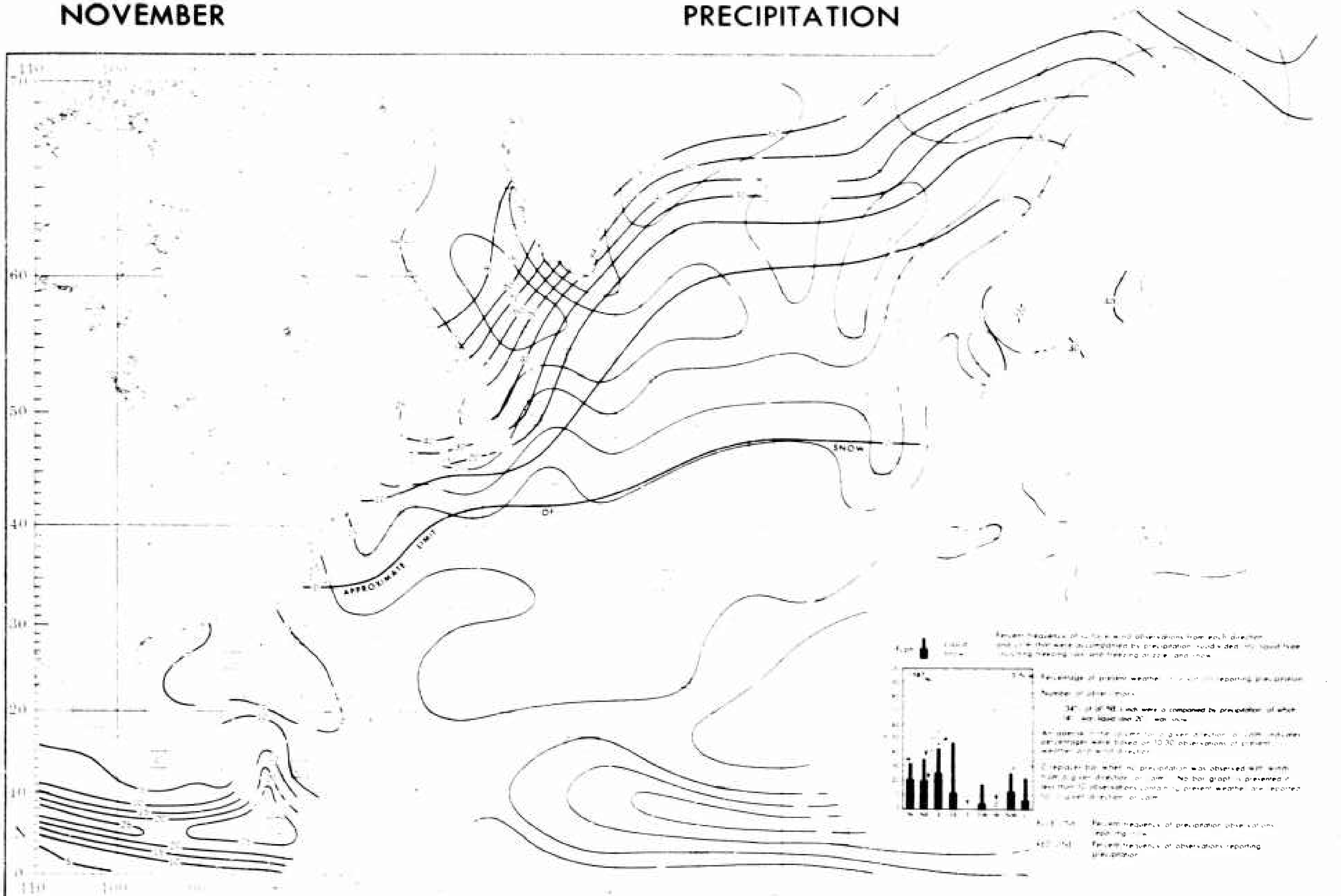


WET BULB AND RELATIVE HUMIDITY

NOVEMBER

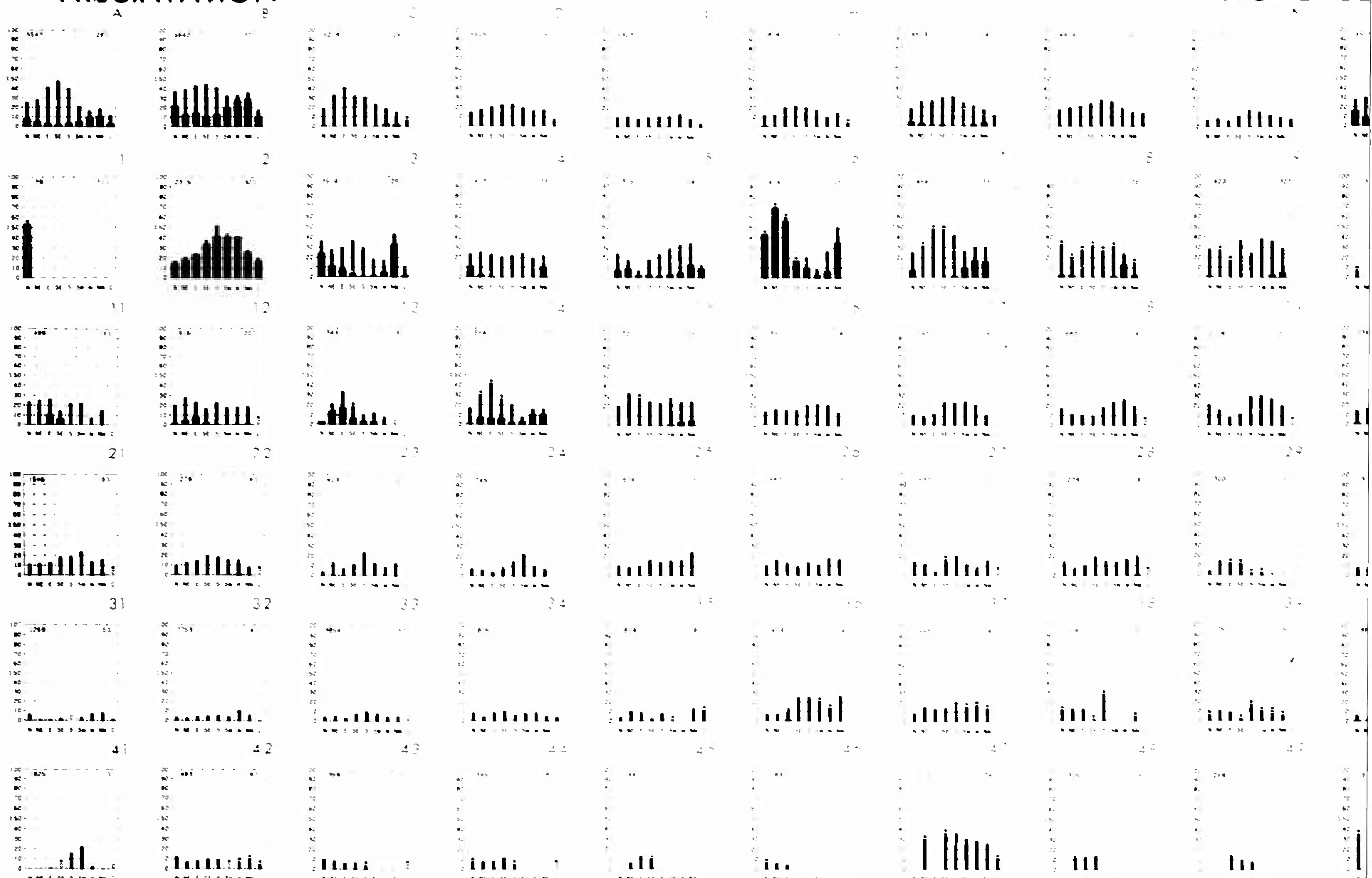


NOVEMBER PRECIPITATION

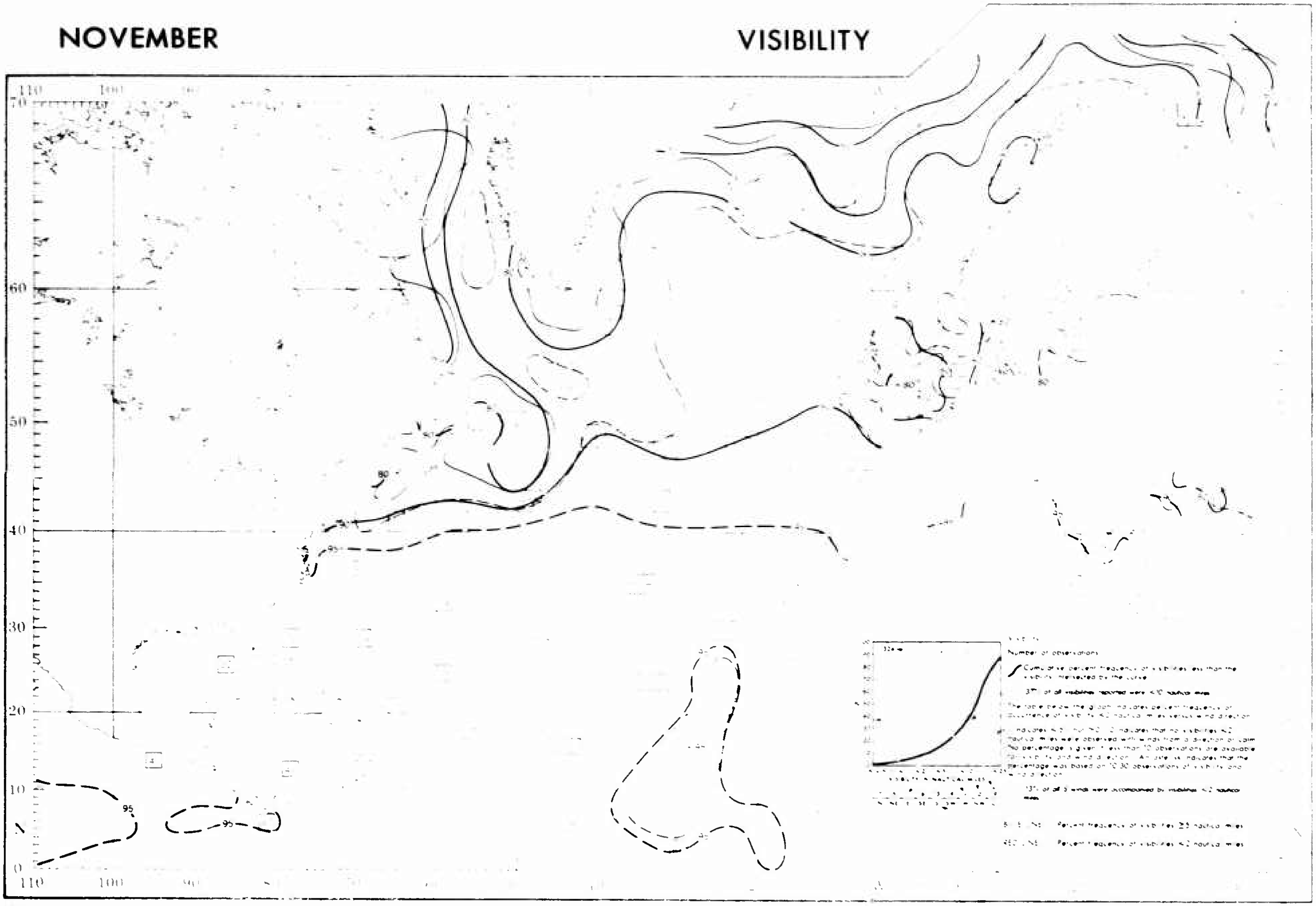


PRECIPITATION

NOVEMBE



NOVEMBER VISIBILITY



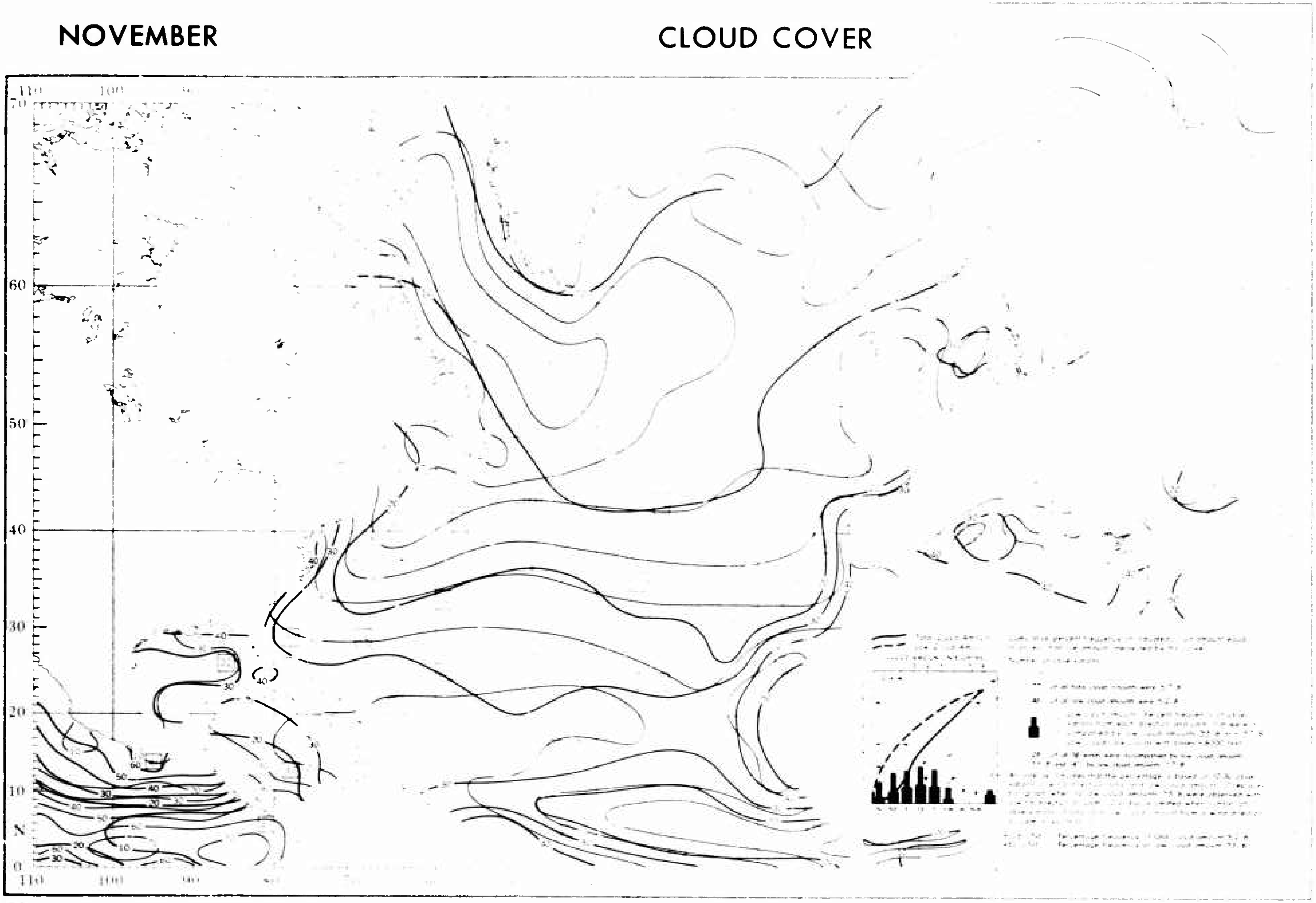
VISIBILITY

NOVEMB

A	B	C	D	E	F
1	2	3	4	[illegible]	[illegible]
11	12	13	[illegible]	[illegible]	[illegible]
21	22	23	24	[illegible]	[illegible]
31	32	33	34	[illegible]	[illegible]
41	42	[illegible]	44	[illegible]	[illegible]

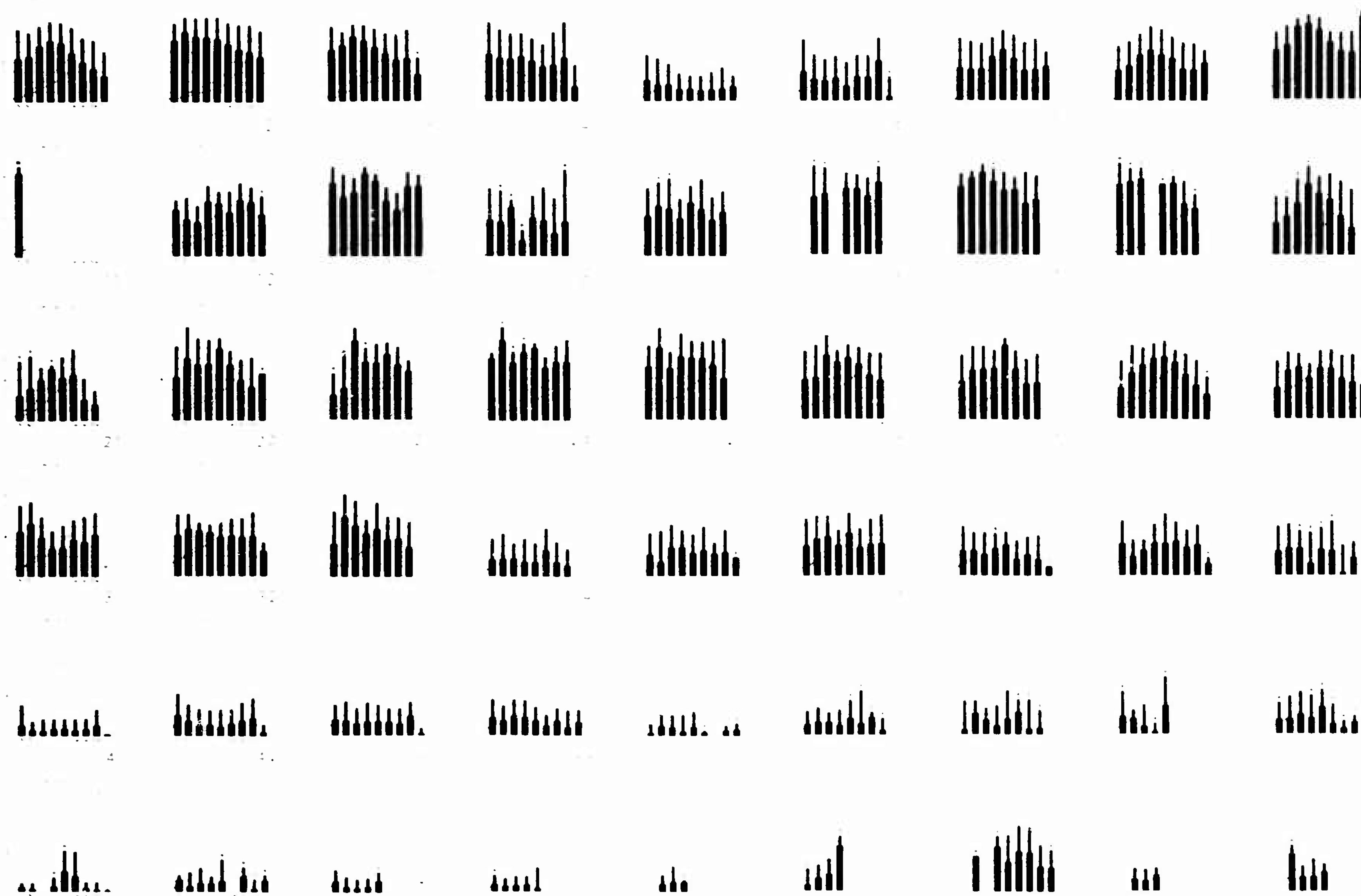
NOVEMBER

CLOUD COVER

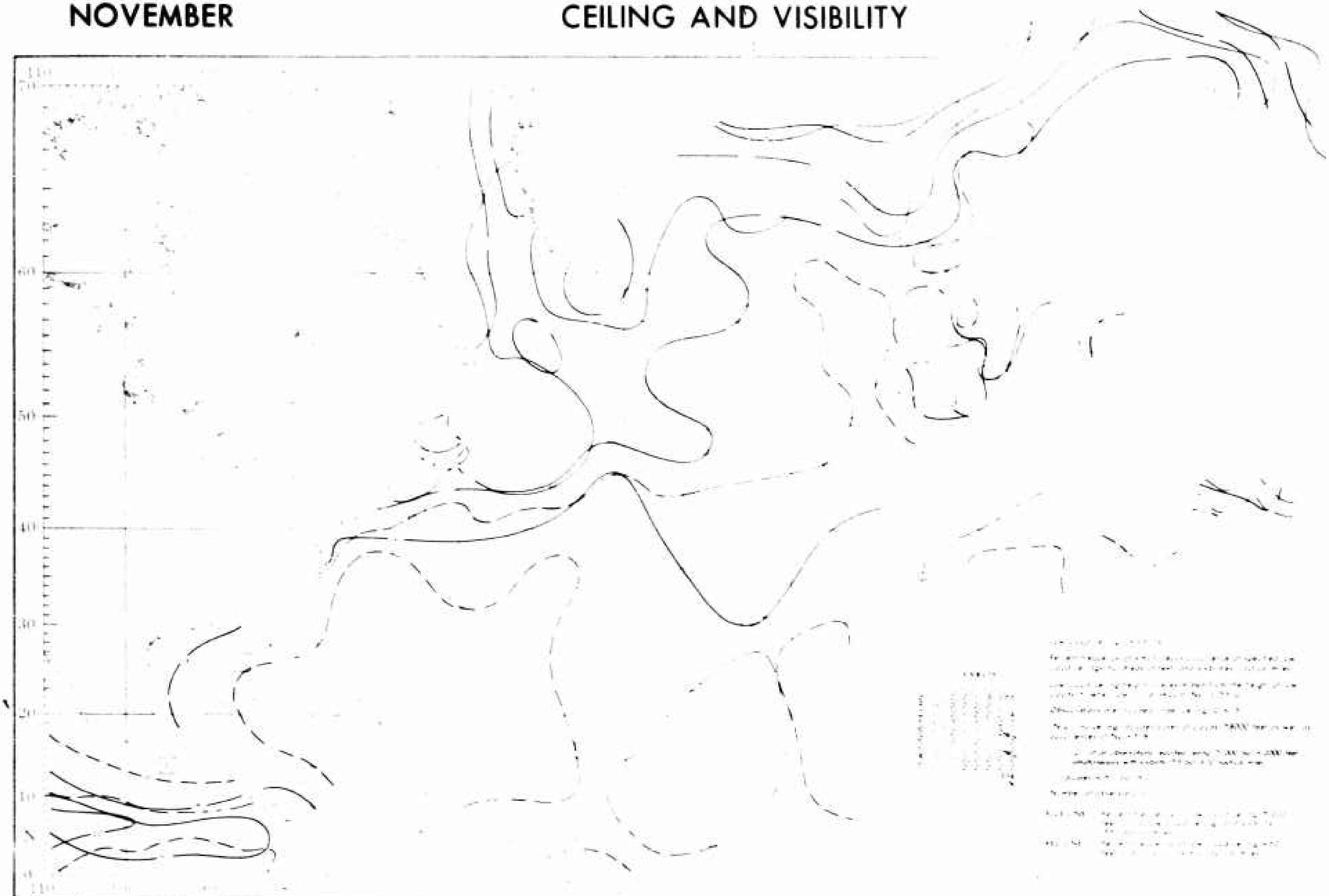


CLOUD COVER

NOVEM



NOVEMBER CEILING AND VISIBILITY

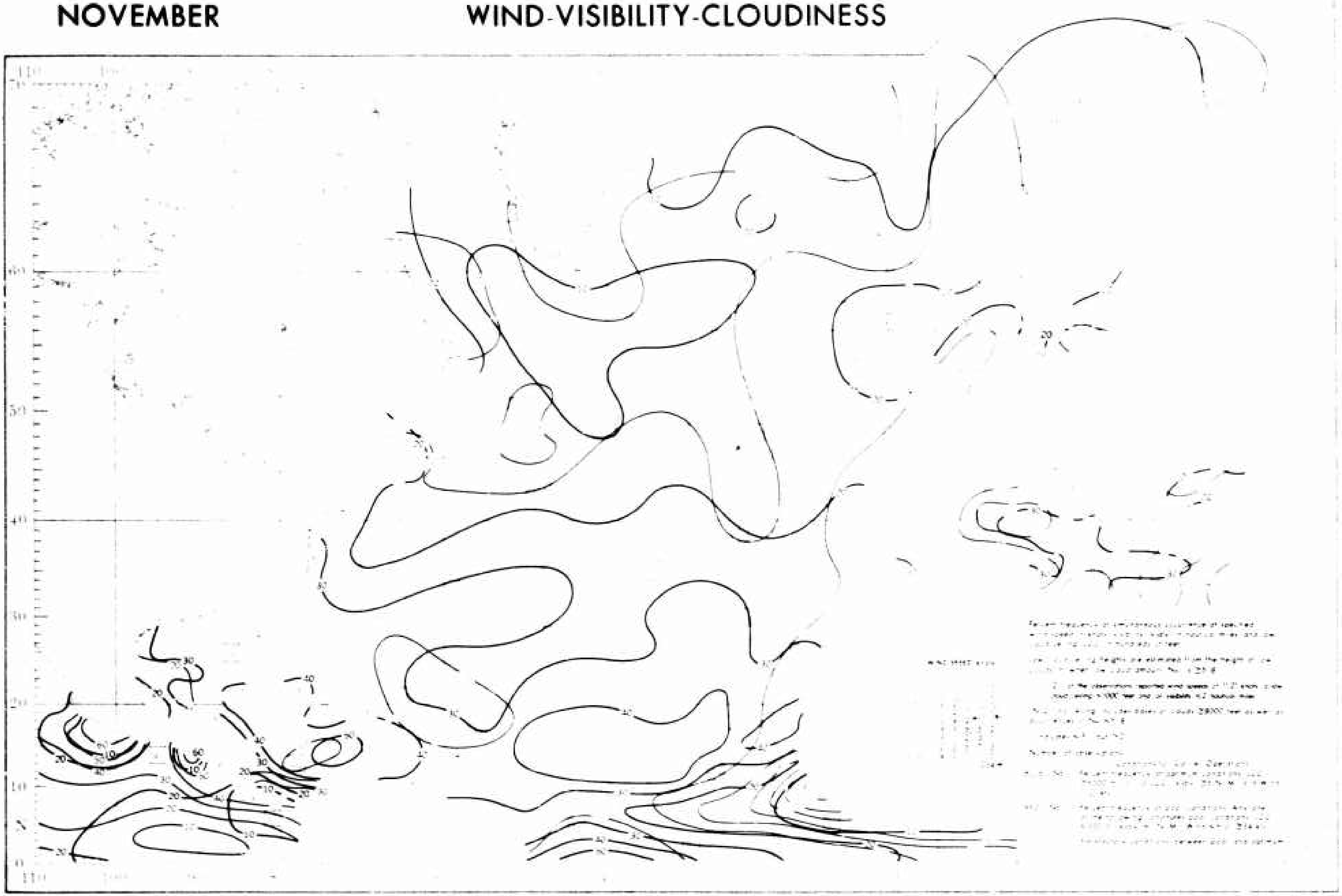


CEILING AND VISIBILITY

NOVEMBER

NOVEMBER

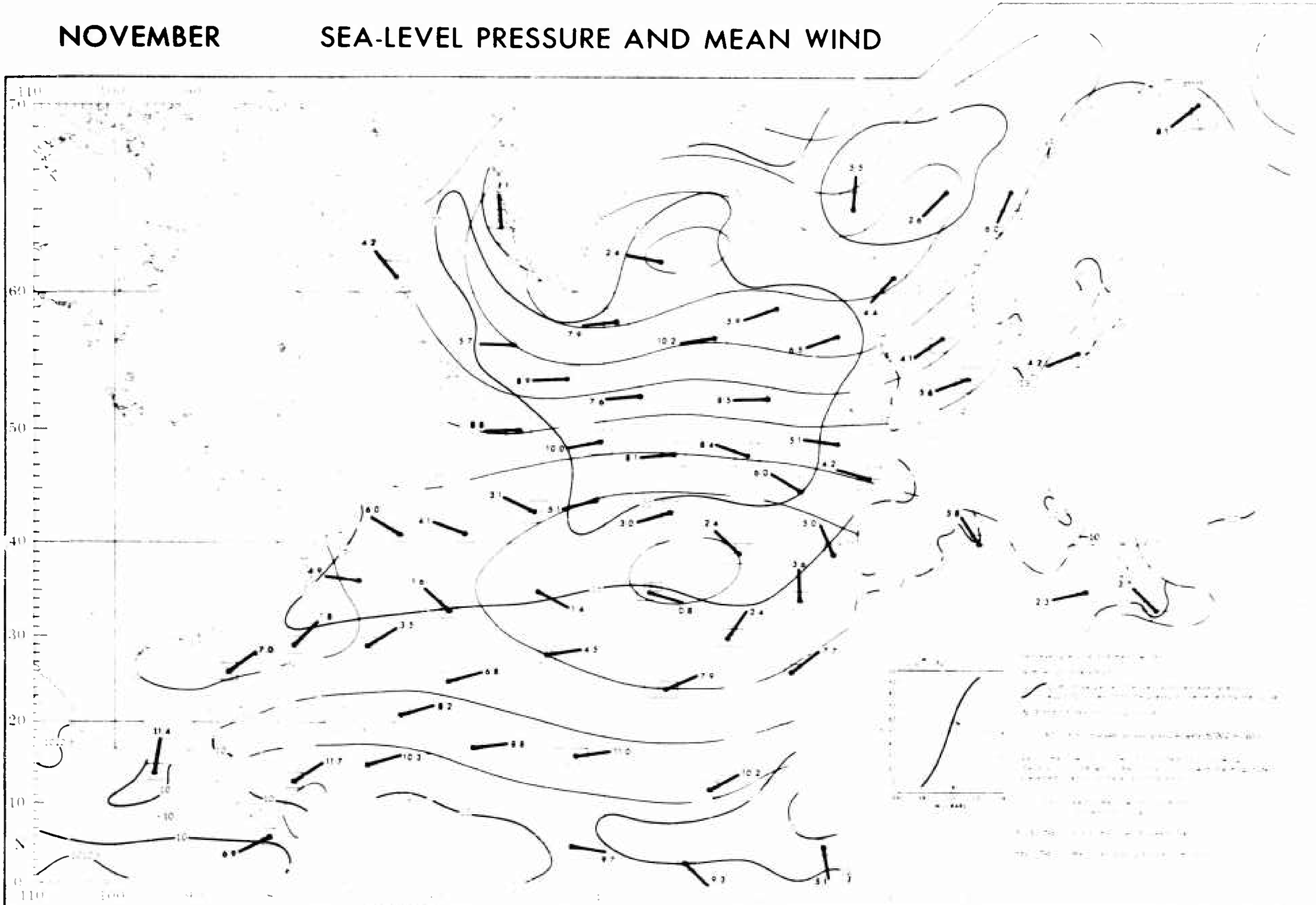
WIND-VISIBILITY-CLOUDINESS



LOW CLOUD CEILING-VISIBILITY-WIND

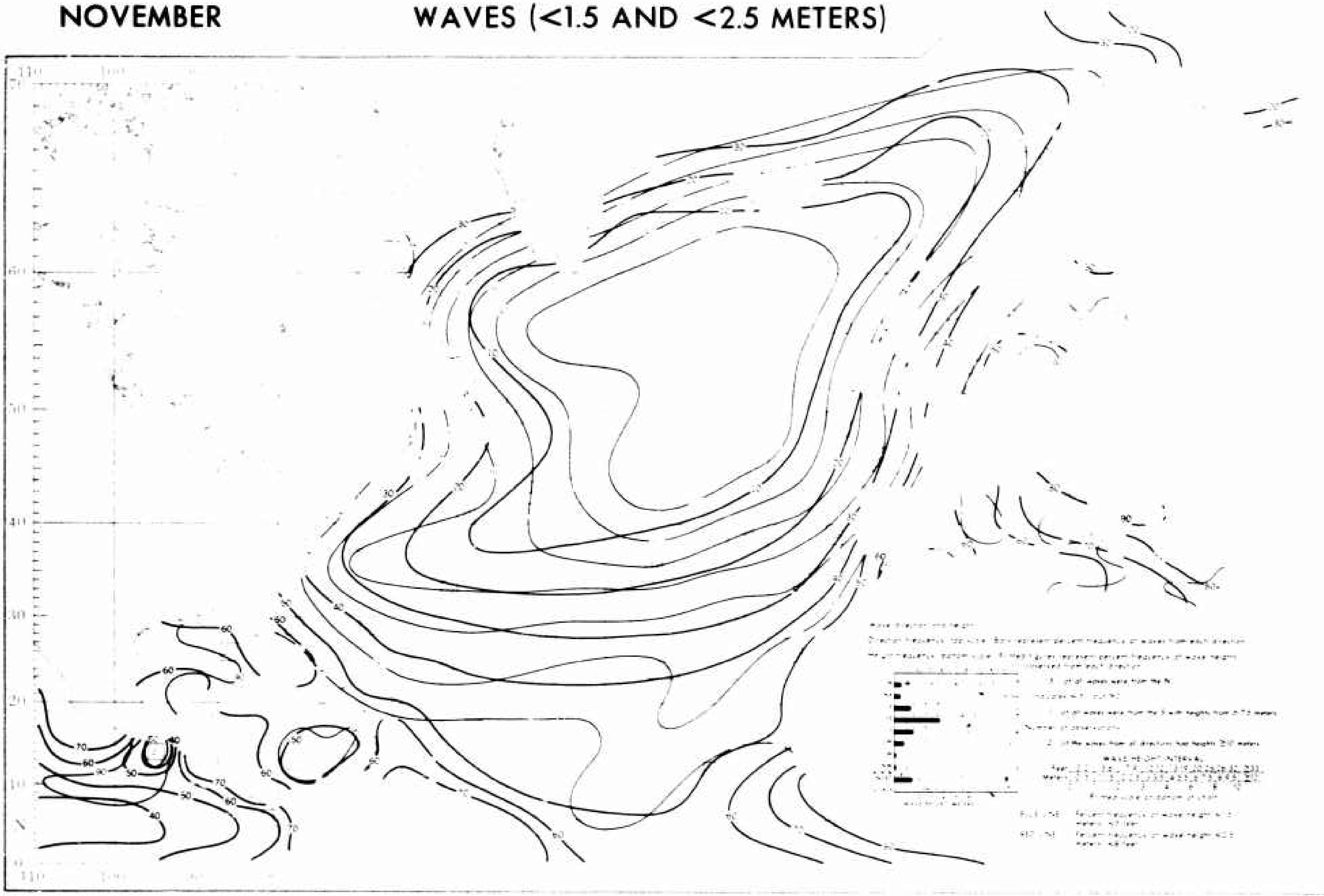
NOVEMBER

NOVEMBER SEA-LEVEL PRESSURE AND MEAN WIND



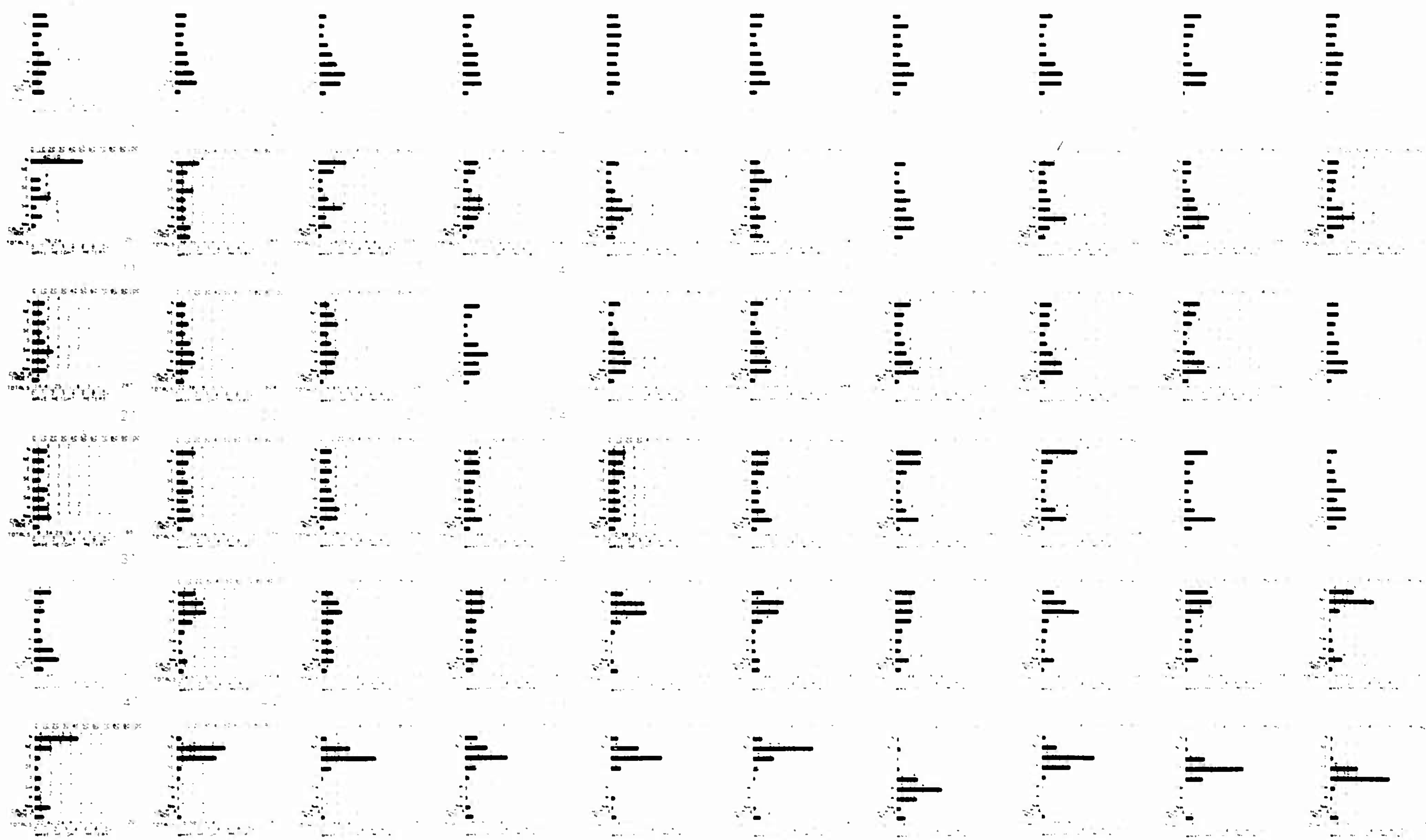
SEA LEVEL PRESSURE NOVEMBER

NOVEMBER WAVES (<1.5 AND <2.5 METERS)



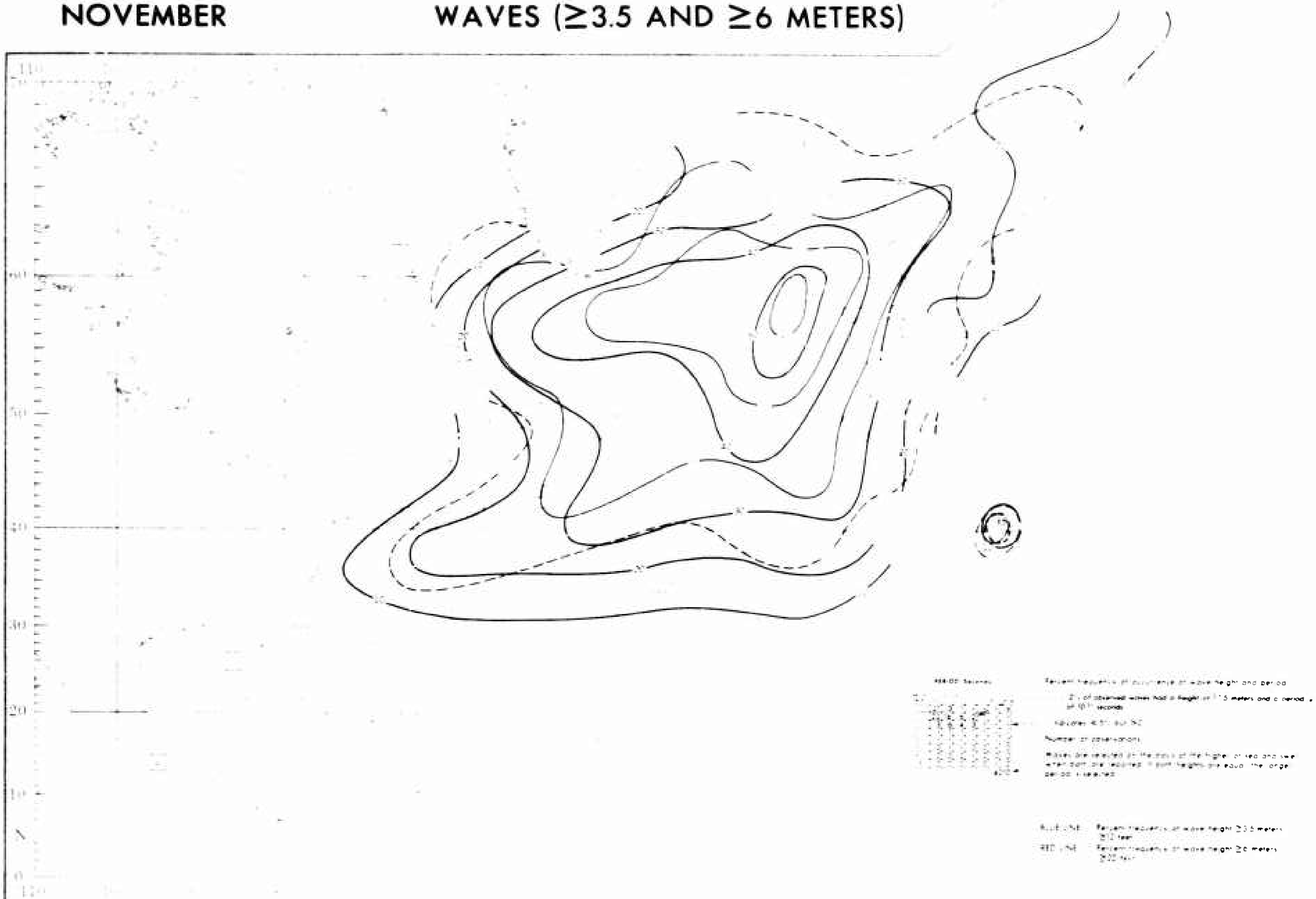
WAVE DIRECTION AND HEIGHT

NOVEMBER



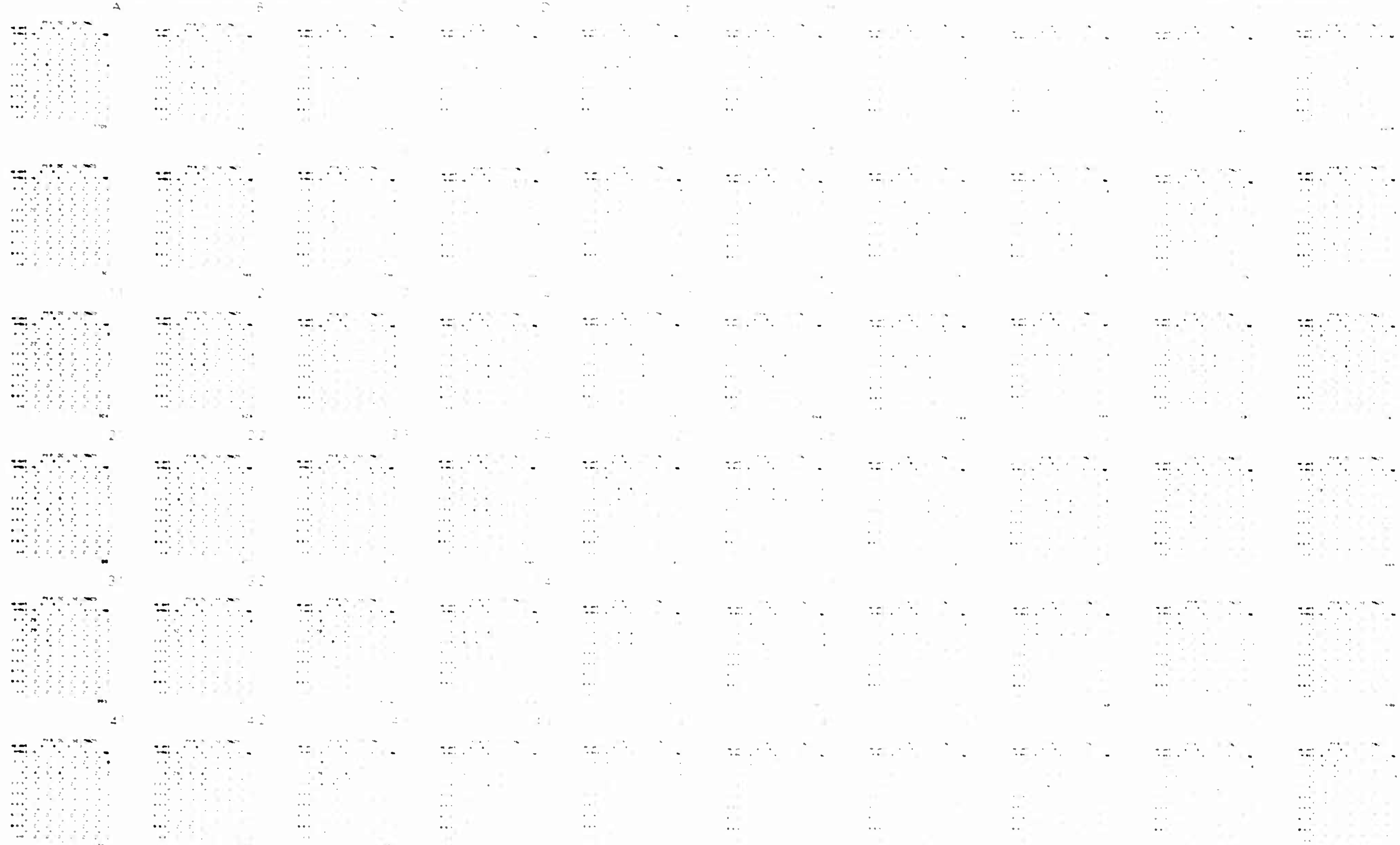
NOVEMBER

WAVES (≥3.5 AND ≥6 METERS)

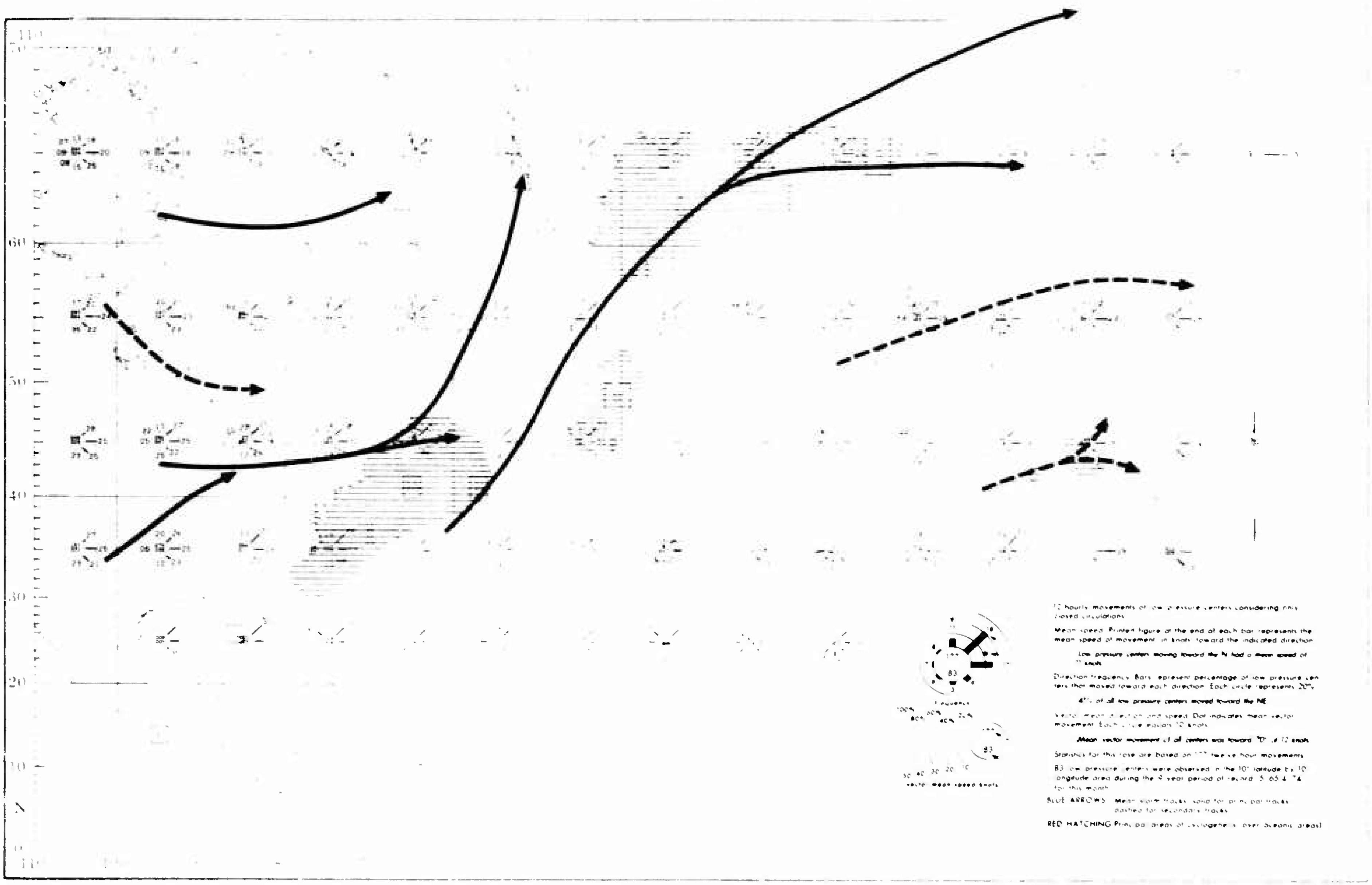


WAVE PERIOD AND HEIGHT

NOVEMBER



NOVEMBER LOW PRESSURE CENTERS



12 hourly movements of low pressure centers considering only closed circulations

Mean speed: Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction

Low pressure centers moving toward the N had a mean speed of 11 knots

Direction frequency: Bars represent percentage of low pressure centers that moved toward each direction. Each circle represents 20%

41% of all low pressure centers moved toward the NE

Vector mean direction and speed: Dot indicates mean vector movement. Each circle equals 10 knots

Mean vector movement of all centers was toward 70° at 12 knots

Statistics for this rose are based on 177 twelve hour movements

83 low pressure centers were observed in the 10° latitude by 10° longitude area during the 9 year period of record (5/65–4/74) for this month

BLUE ARROWS: Mean storm tracks; solid for principal tracks, dashed for secondary tracks

RED HATCHING: Principal areas of cyclogenesis (over oceanic areas)

TROPICAL CYCLONE

NOVEMBER

12 hourly movements of tropical cyclone centers with tropical storm intensity or greater wind speed estimated ≥34 knots

Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

Centers moving toward the N had a mean speed of 5 knots

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

35% of all tropical cyclones moved toward the NE

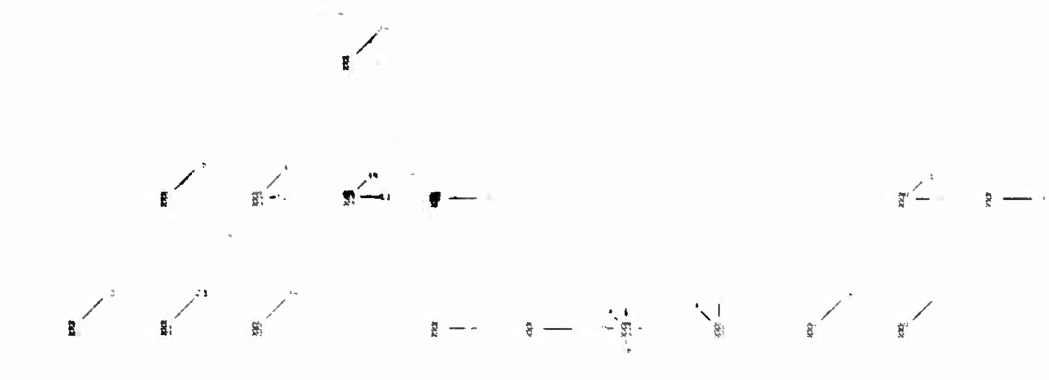
Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

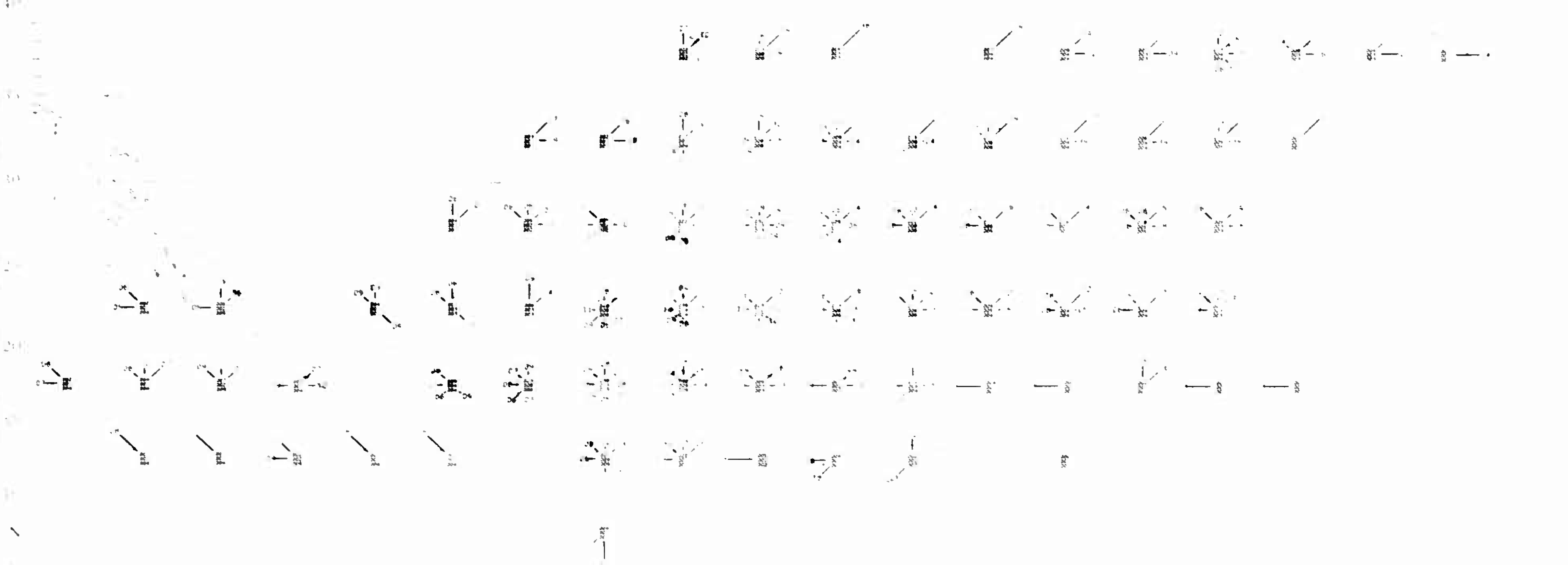
Mean vector movement of all centers was toward 75° at 7 knots

Statistics for this rose are based on 277 twelve hour movements.

50 individual storms were observed in the 5° X 5° area during the period of record.

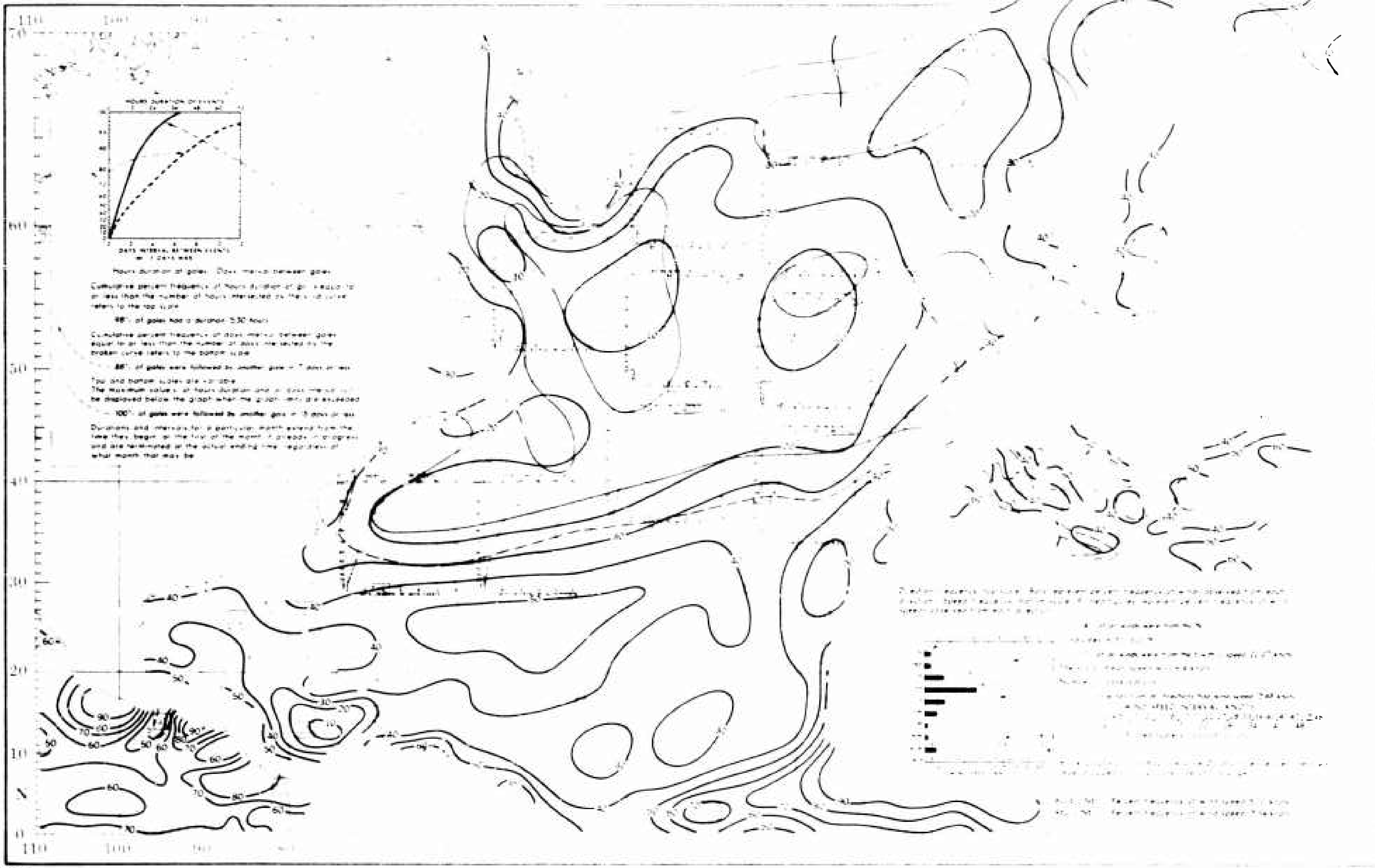
Probability of having at least one tropical cyclone in this area in any given year for this month is 26%.





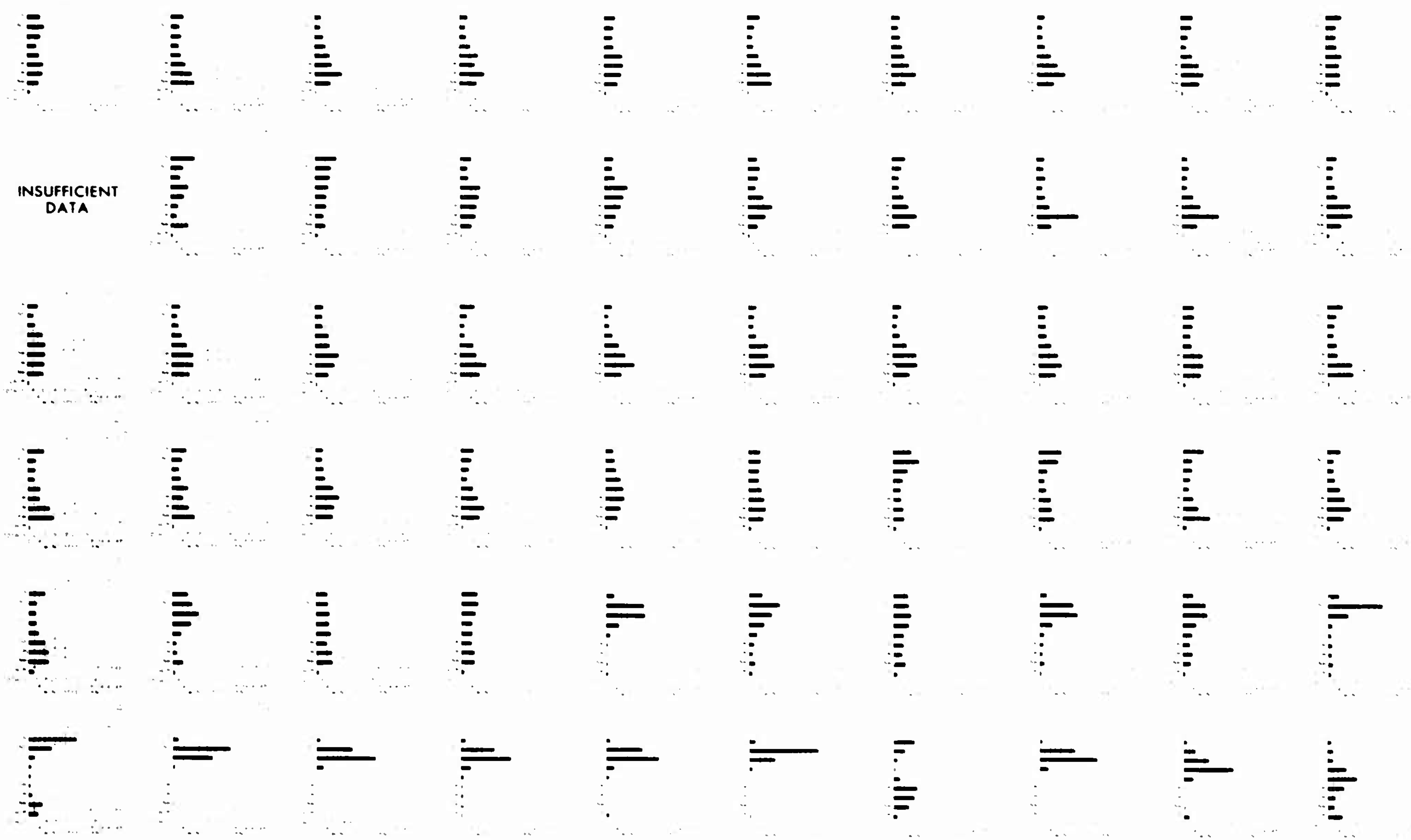
DECEMBER

SURFACE WINDS



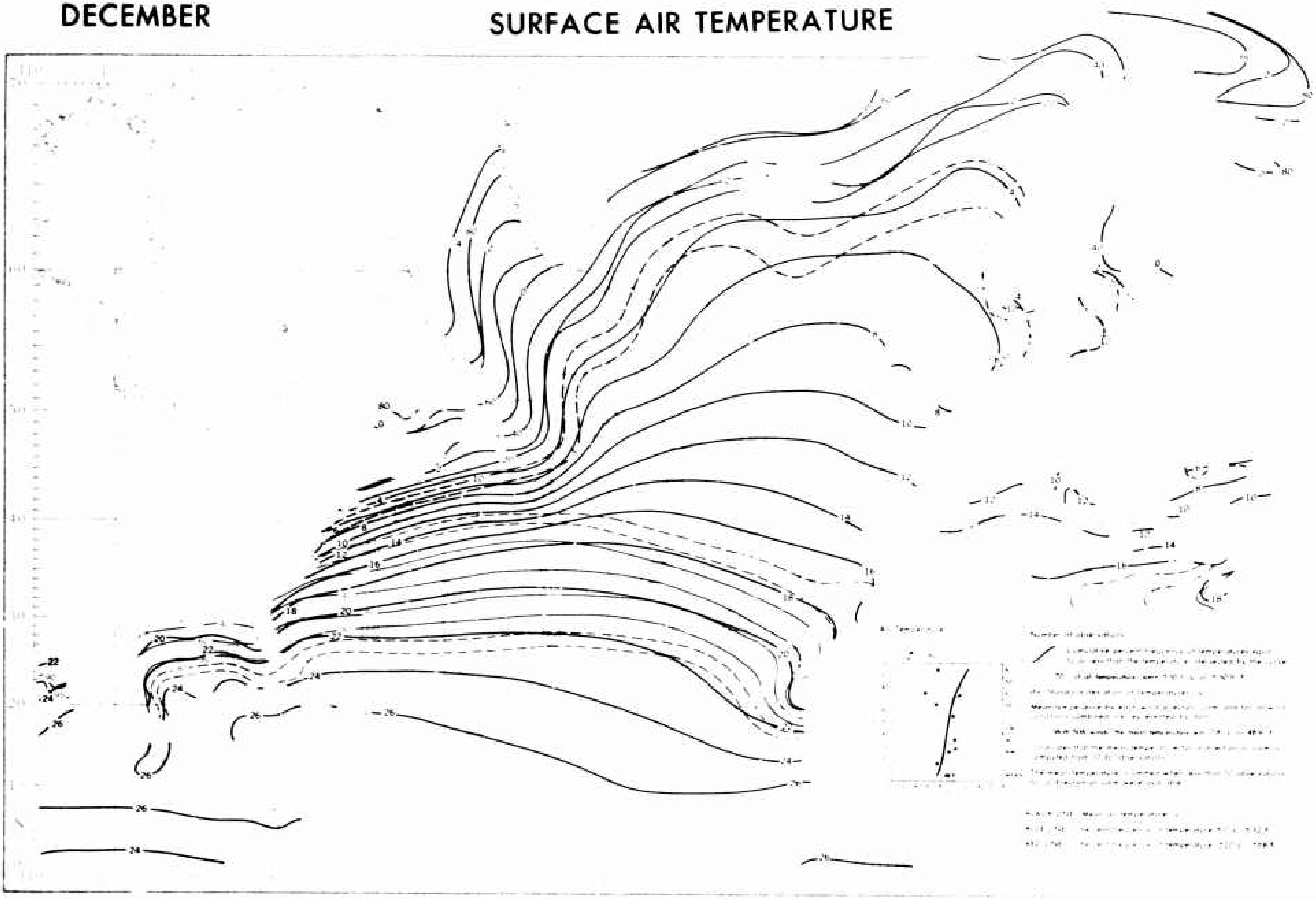
WIND DIRECTION AND SPEED

DECEMBER



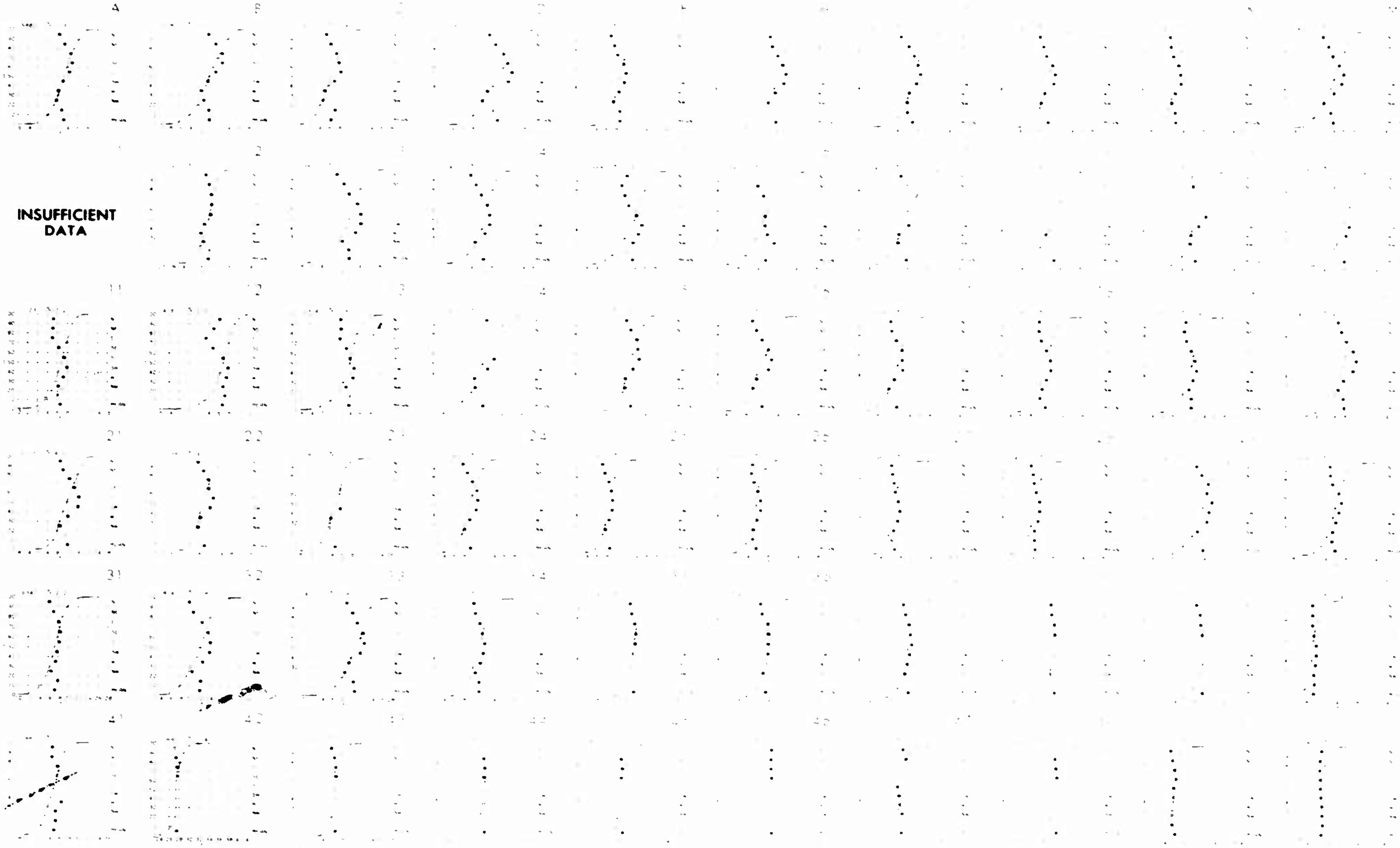
DECEMBER

SURFACE AIR TEMPERATURE

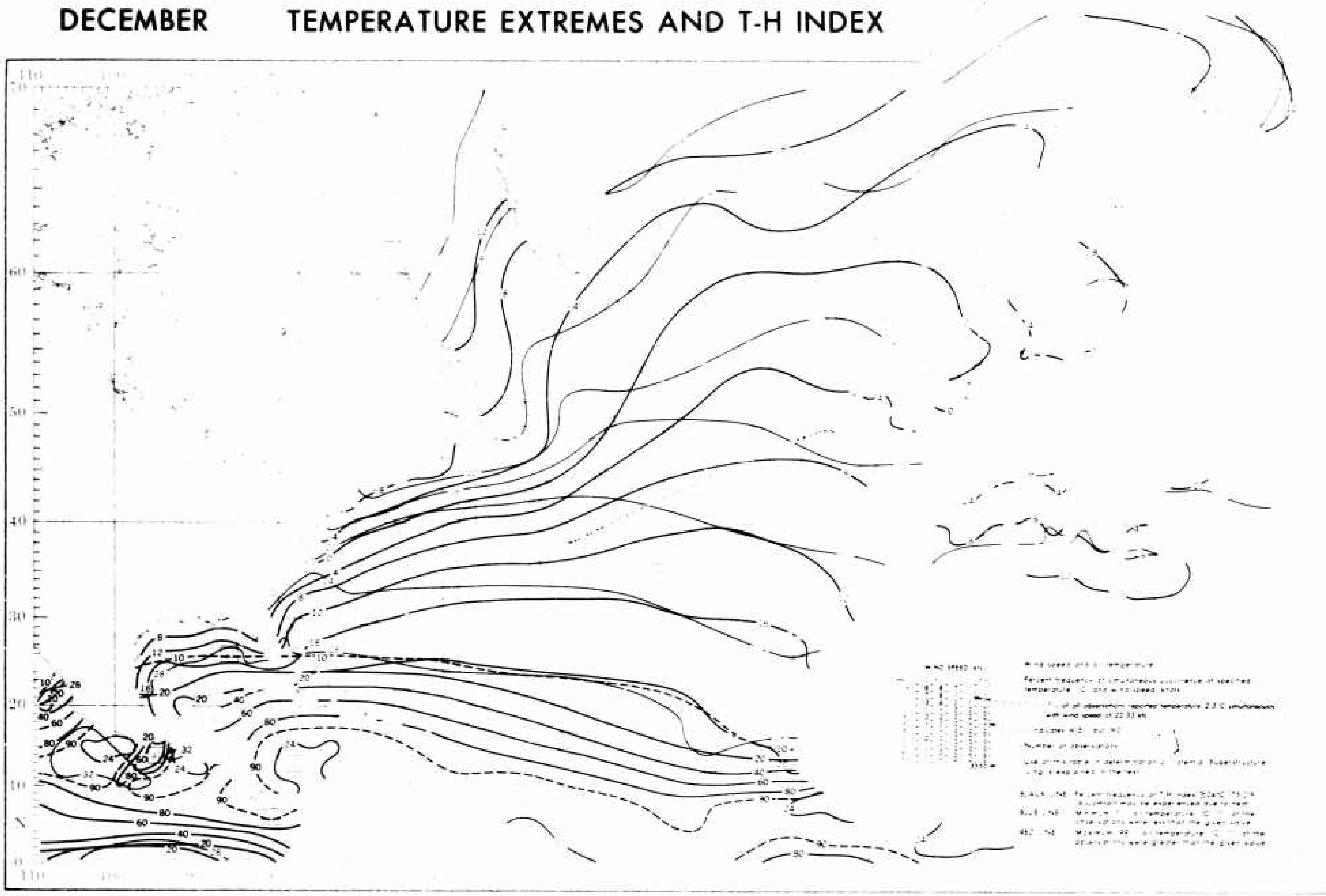


SURFACE AIR TEMPERATURE

DECEMBER



DECEMBER TEMPERATURE EXTREMES AND T-H INDEX



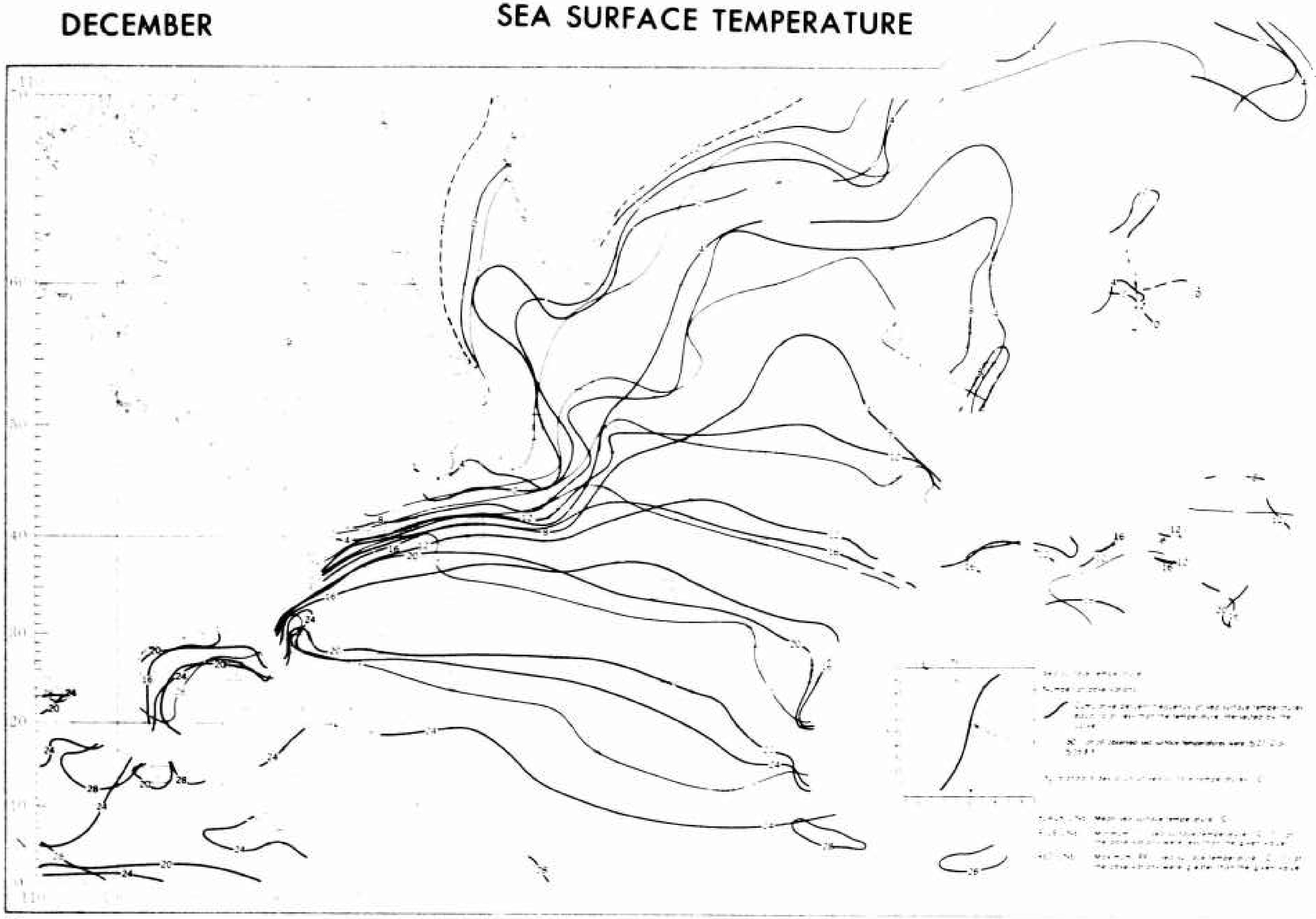
WIND SPEED AND AIR TEMPERATURE

DECEMBER

INSUFFICIENT DATA

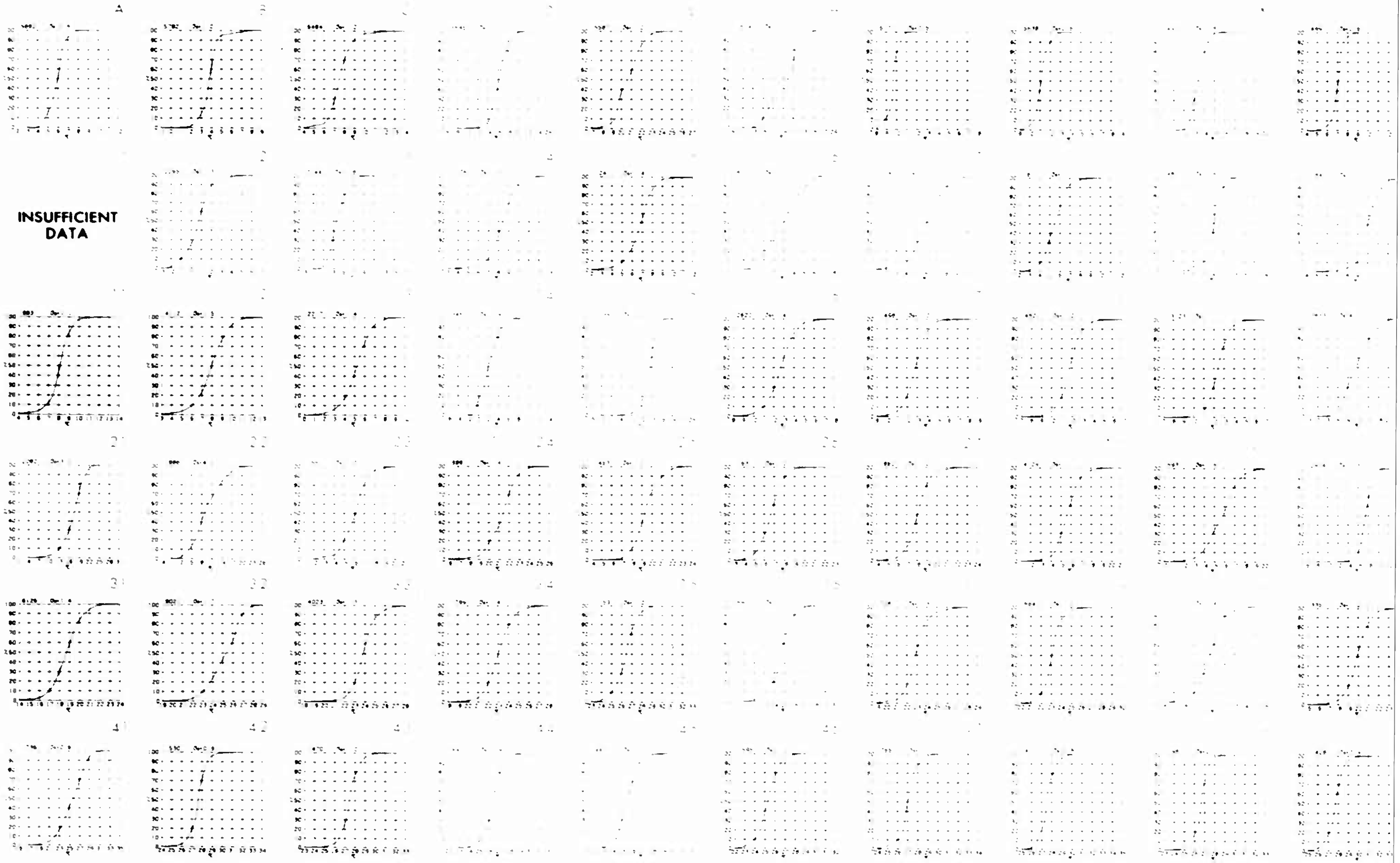
DECEMBER

SEA SURFACE TEMPERATURE



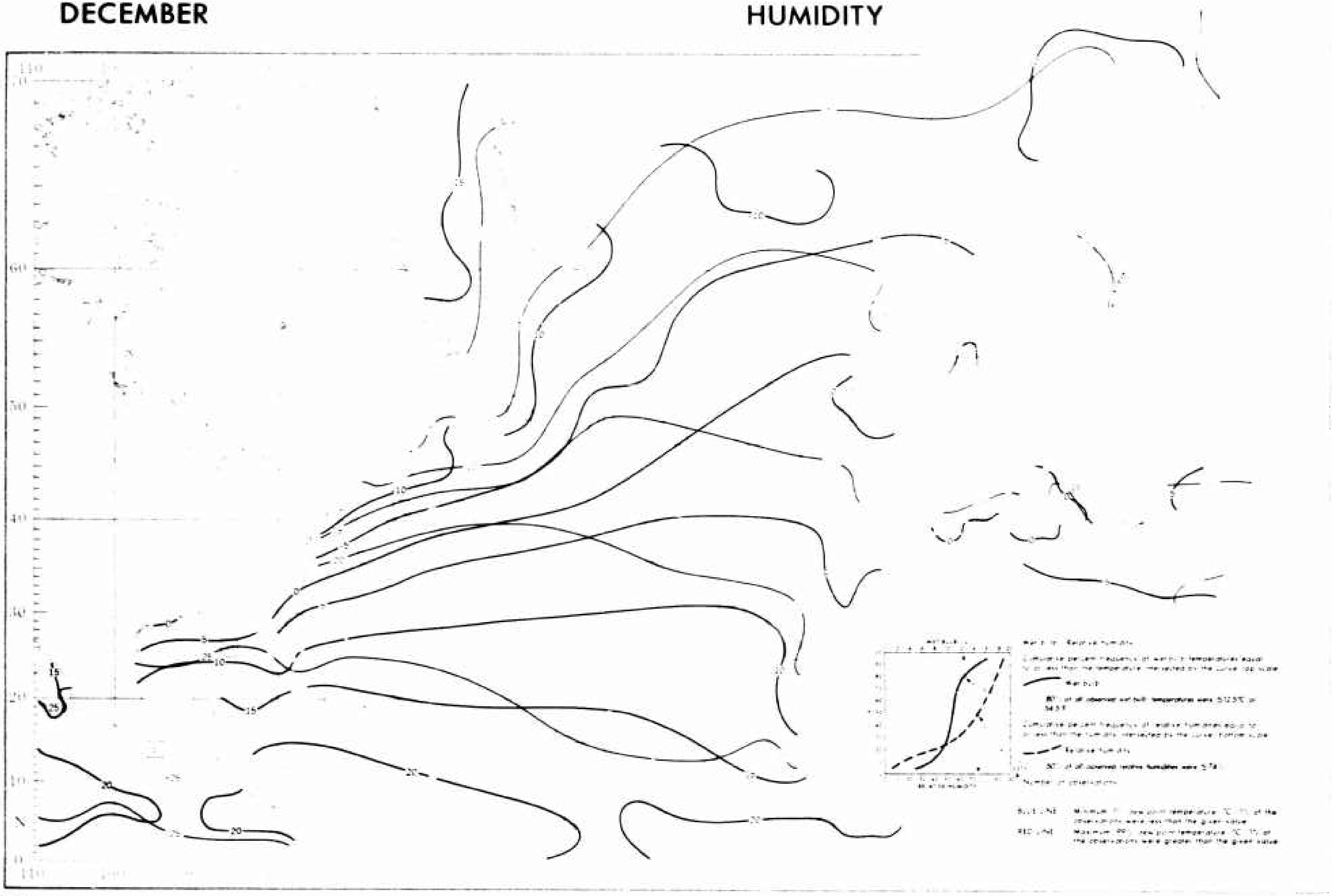
SEA SURFACE TEMPERATURE

DECEMBER



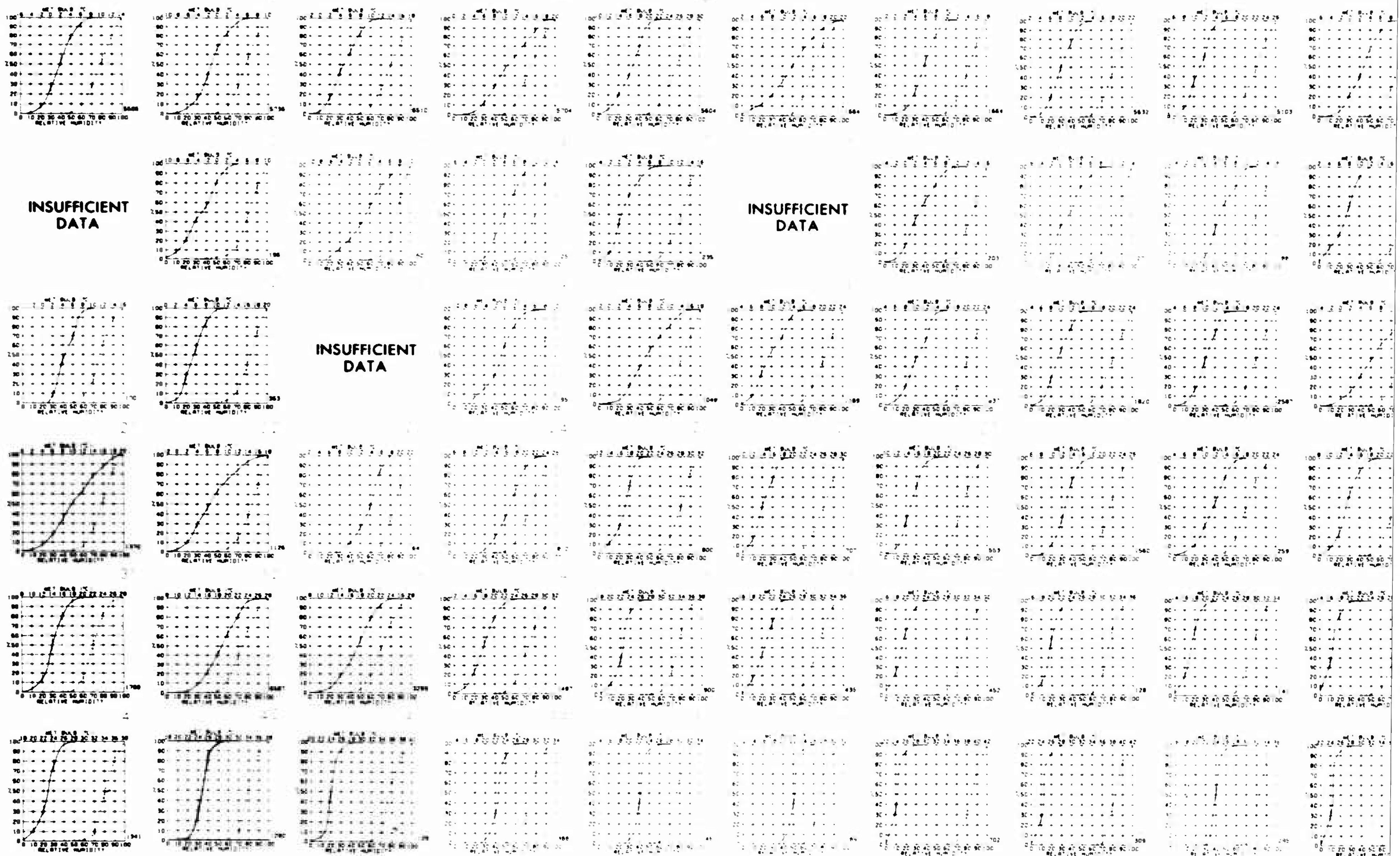
DECEMBER

HUMIDITY



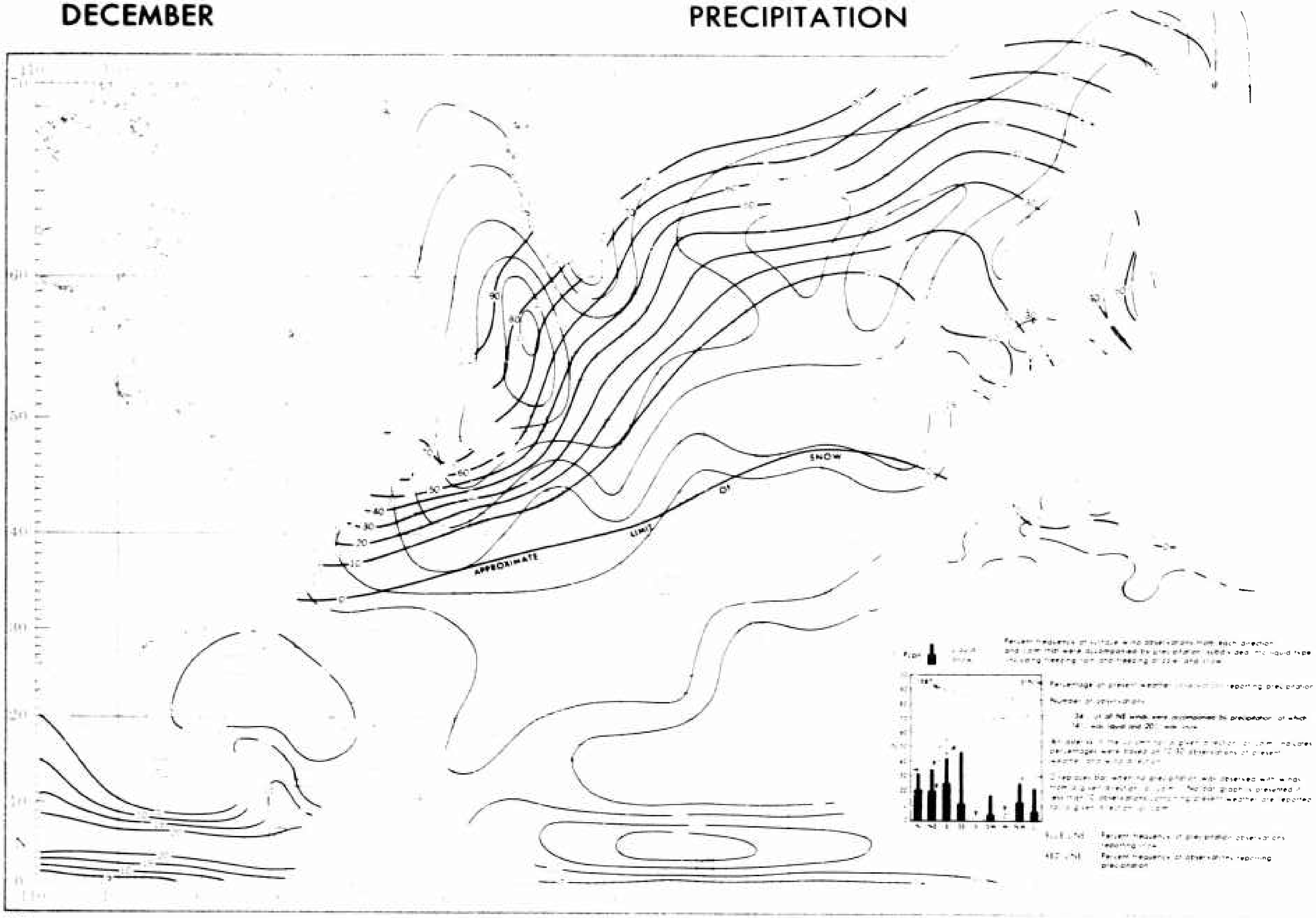
WET BULB AND RELATIVE HUMIDITY

DECEMBER



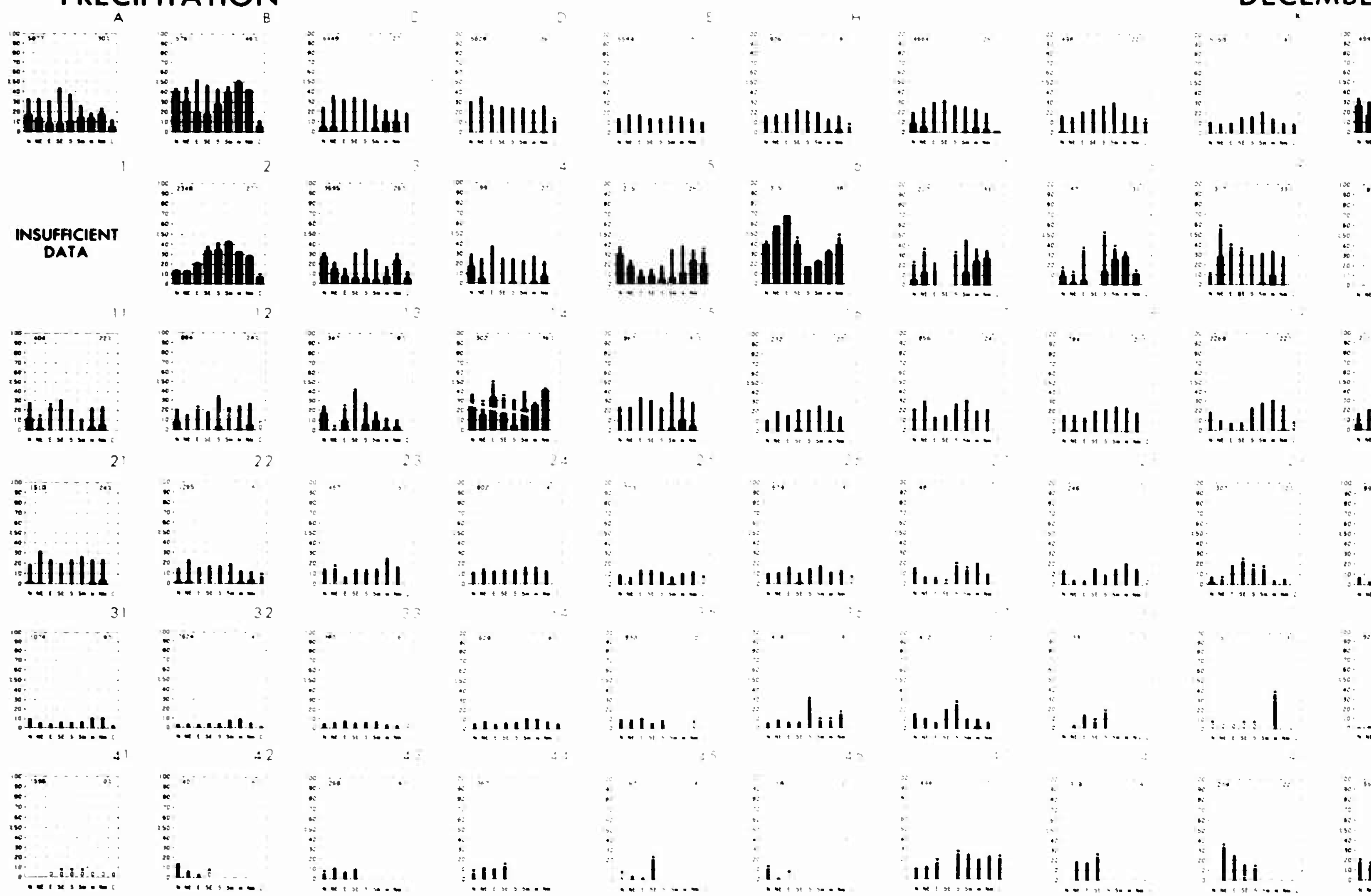
DECEMBER

PRECIPITATION

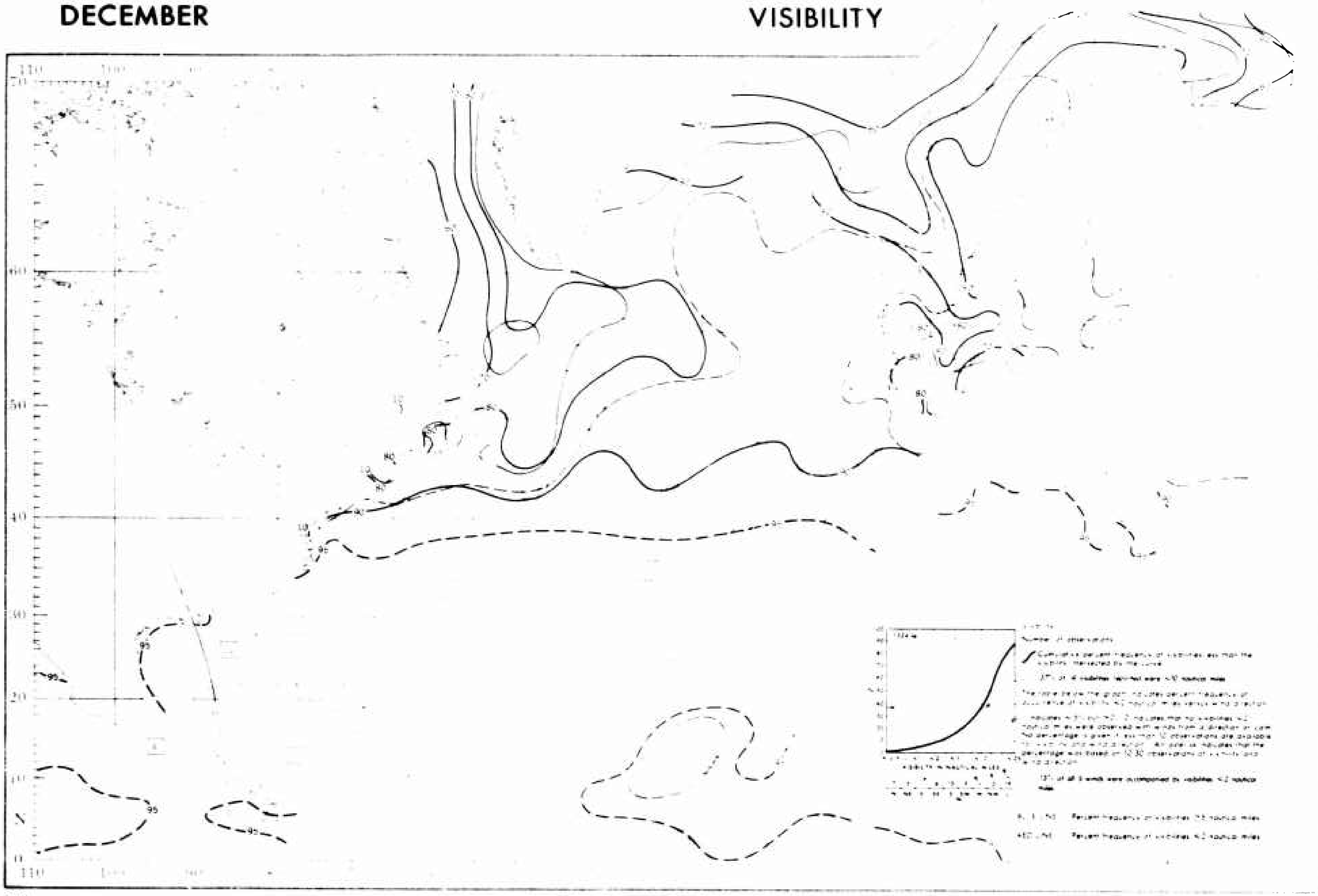


PRECIPITATION

DECEMBER



DECEMBER VISIBILITY

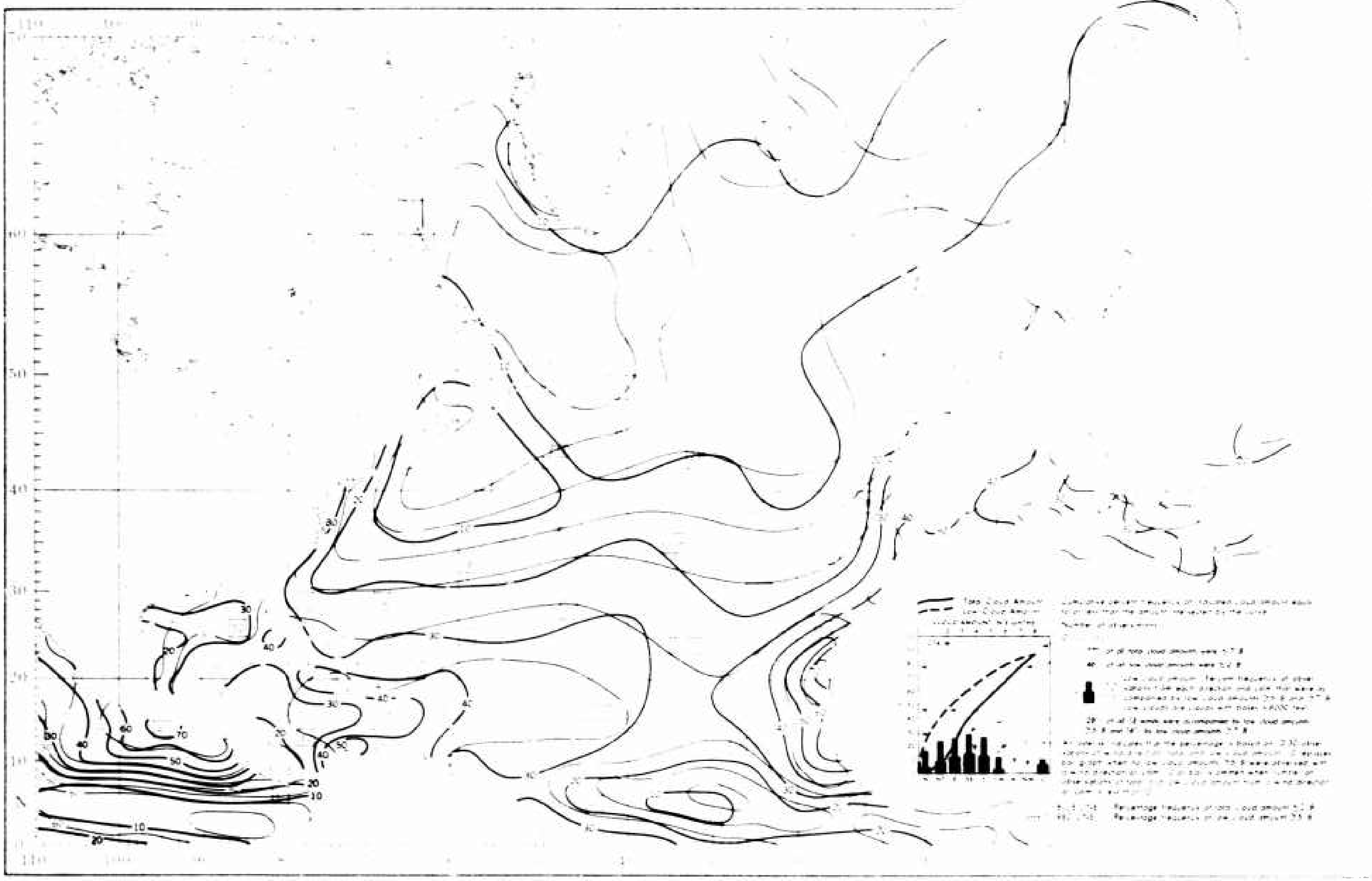


VISIBILITY

DECEMBE

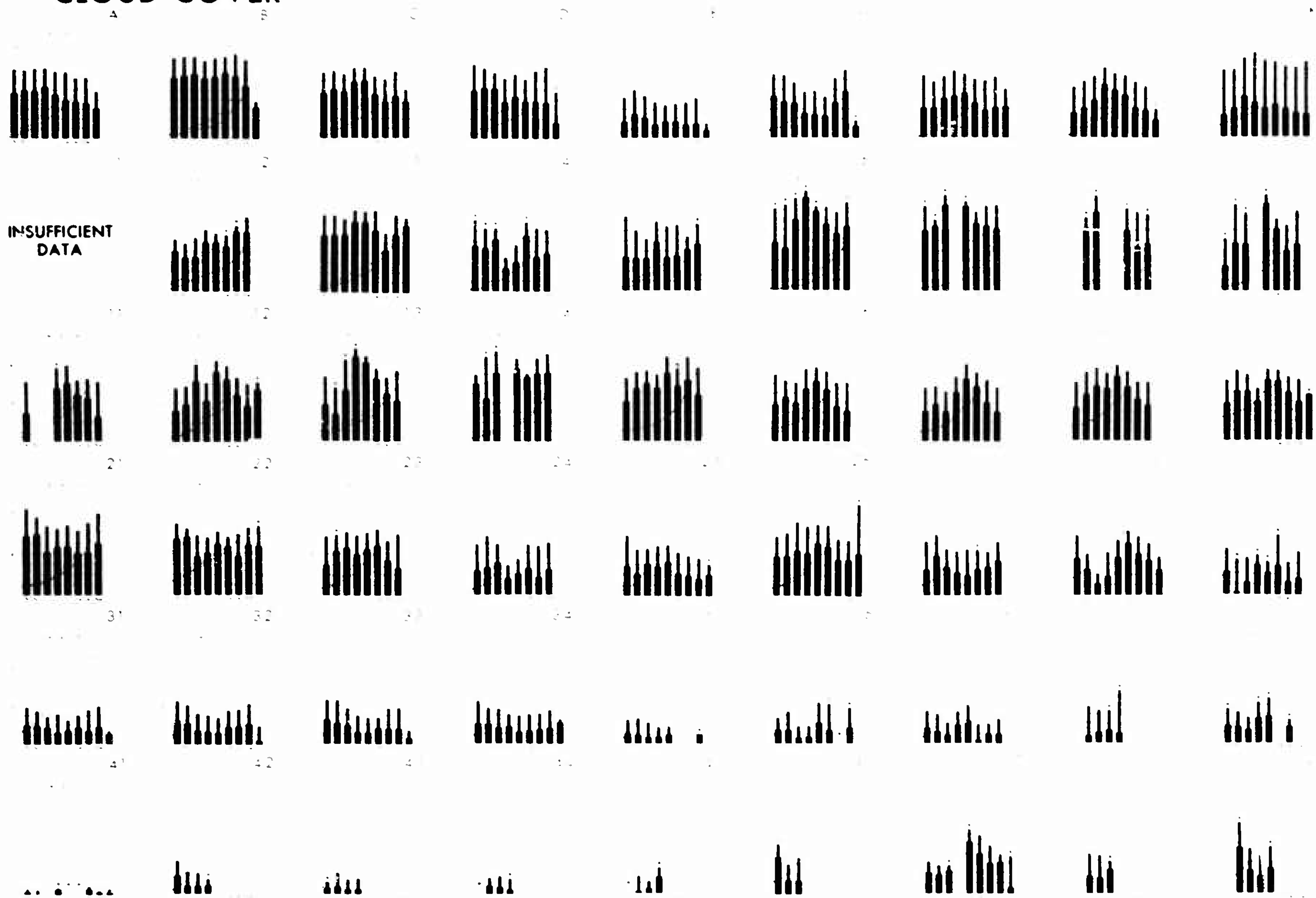
INSUFFICIENT DATA

DECEMBER CLOUD COVER



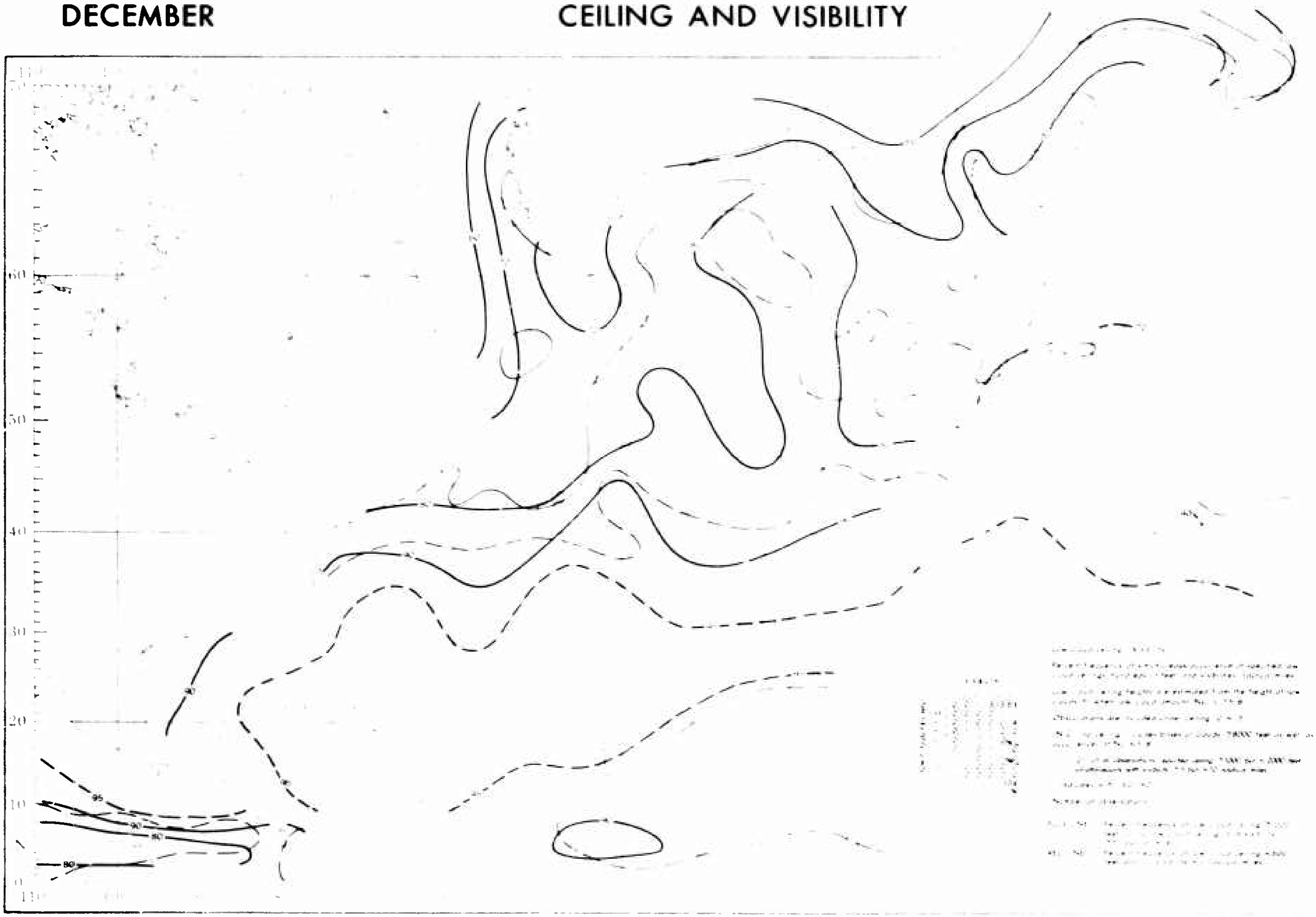
CLOUD COVER

DECEM



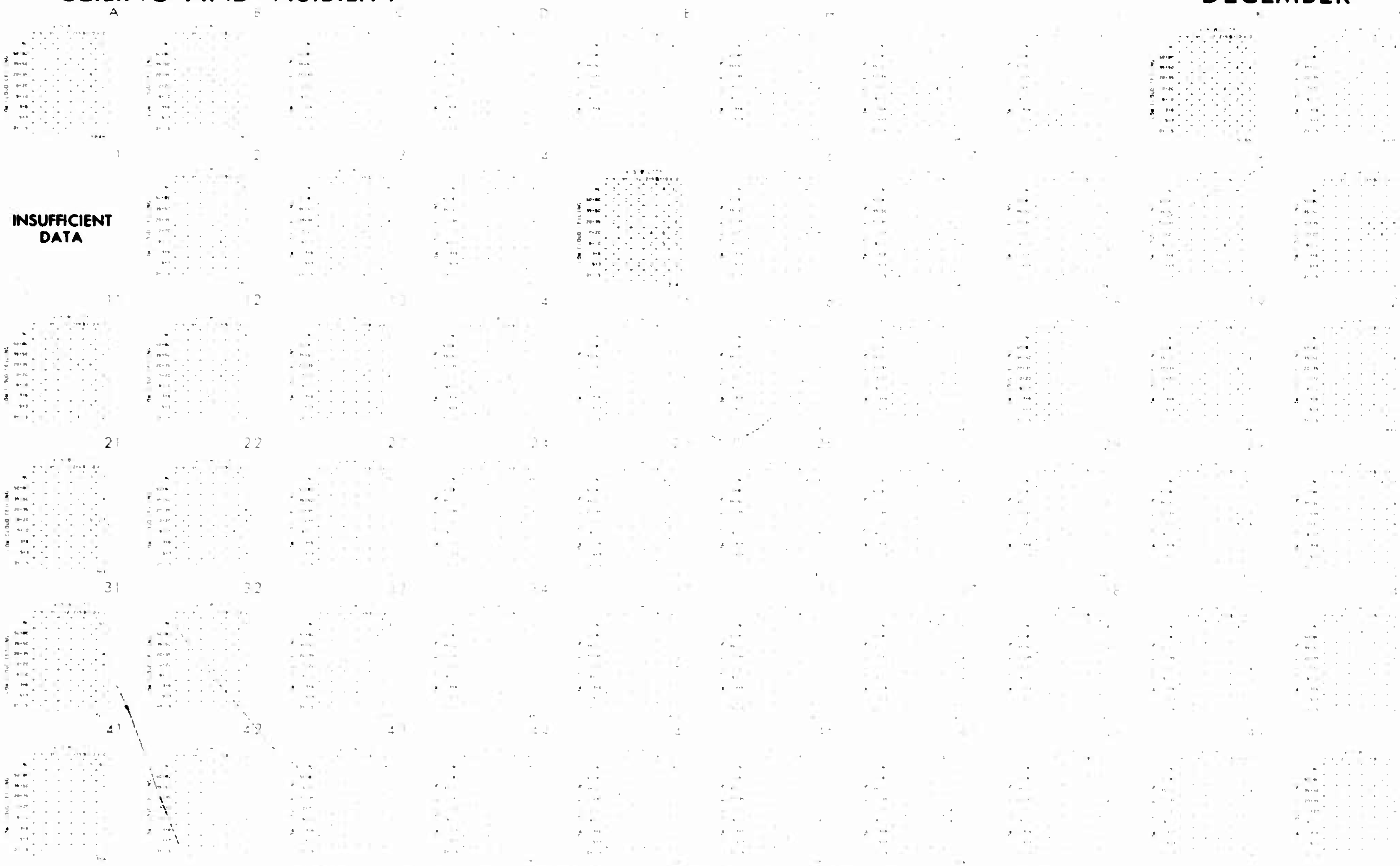
DECEMBER

CEILING AND VISIBILITY

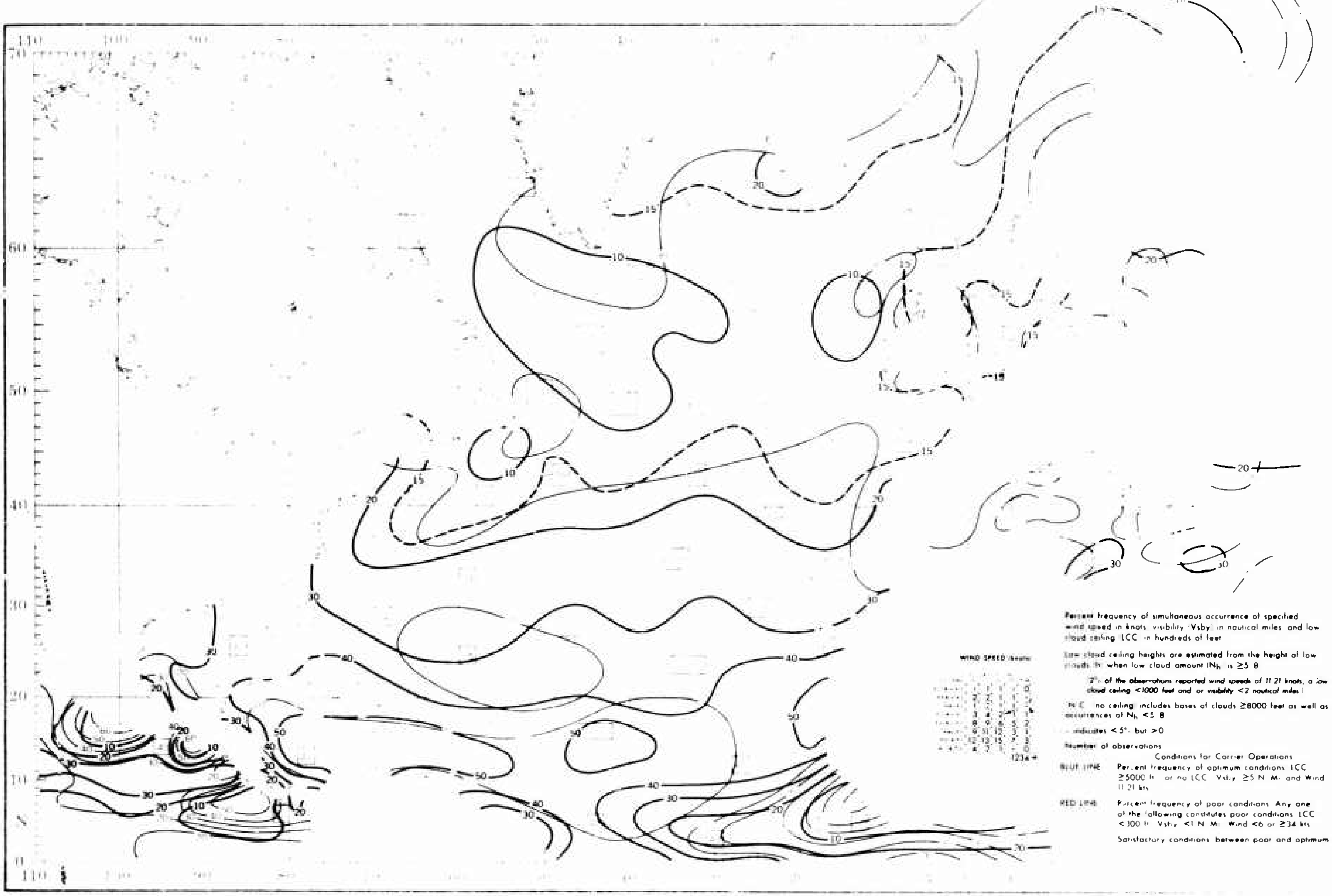


CEILING AND VISIBILITY

DECEMBER

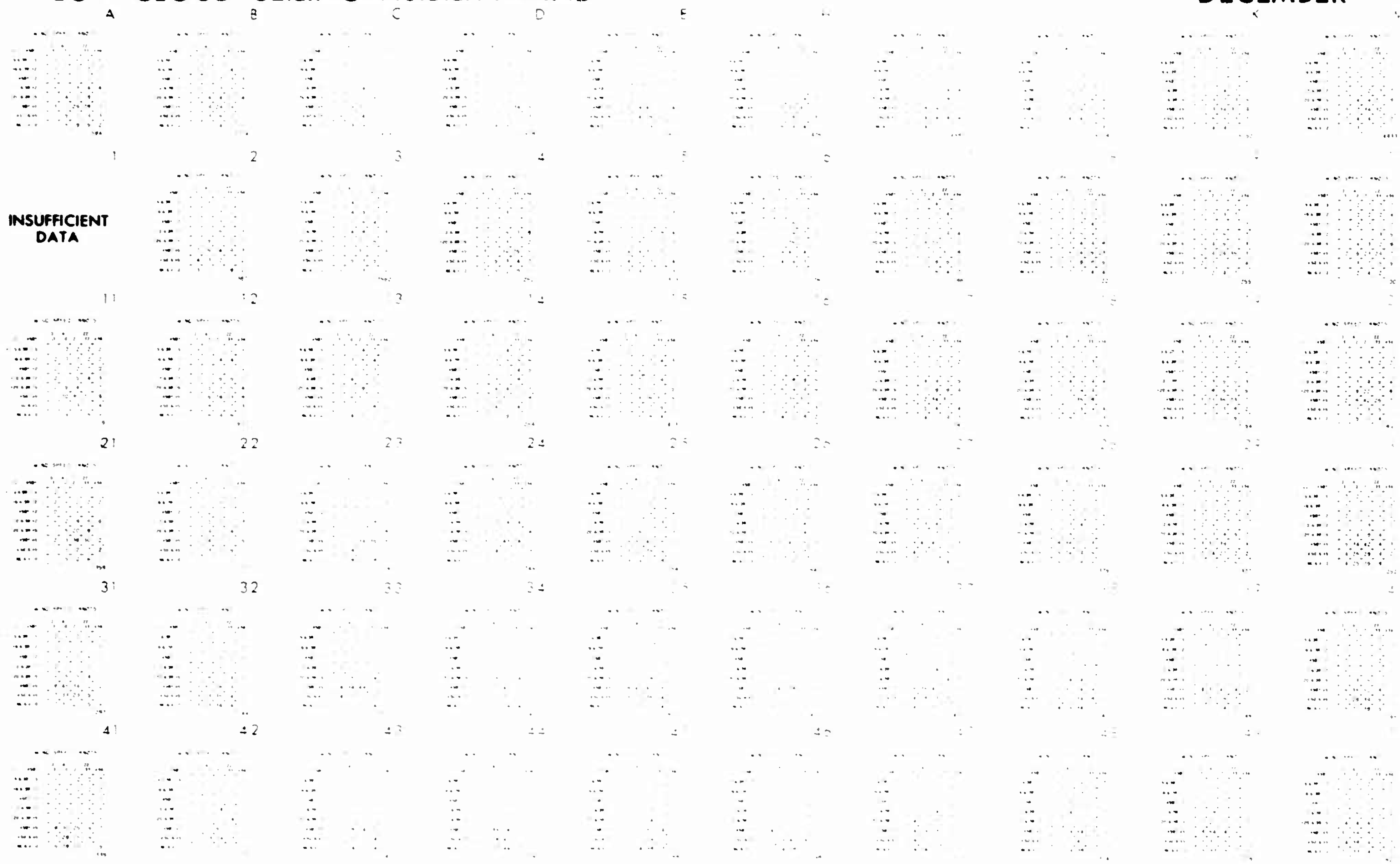


DECEMBER WIND-VISIBILITY-CLOUDINESS

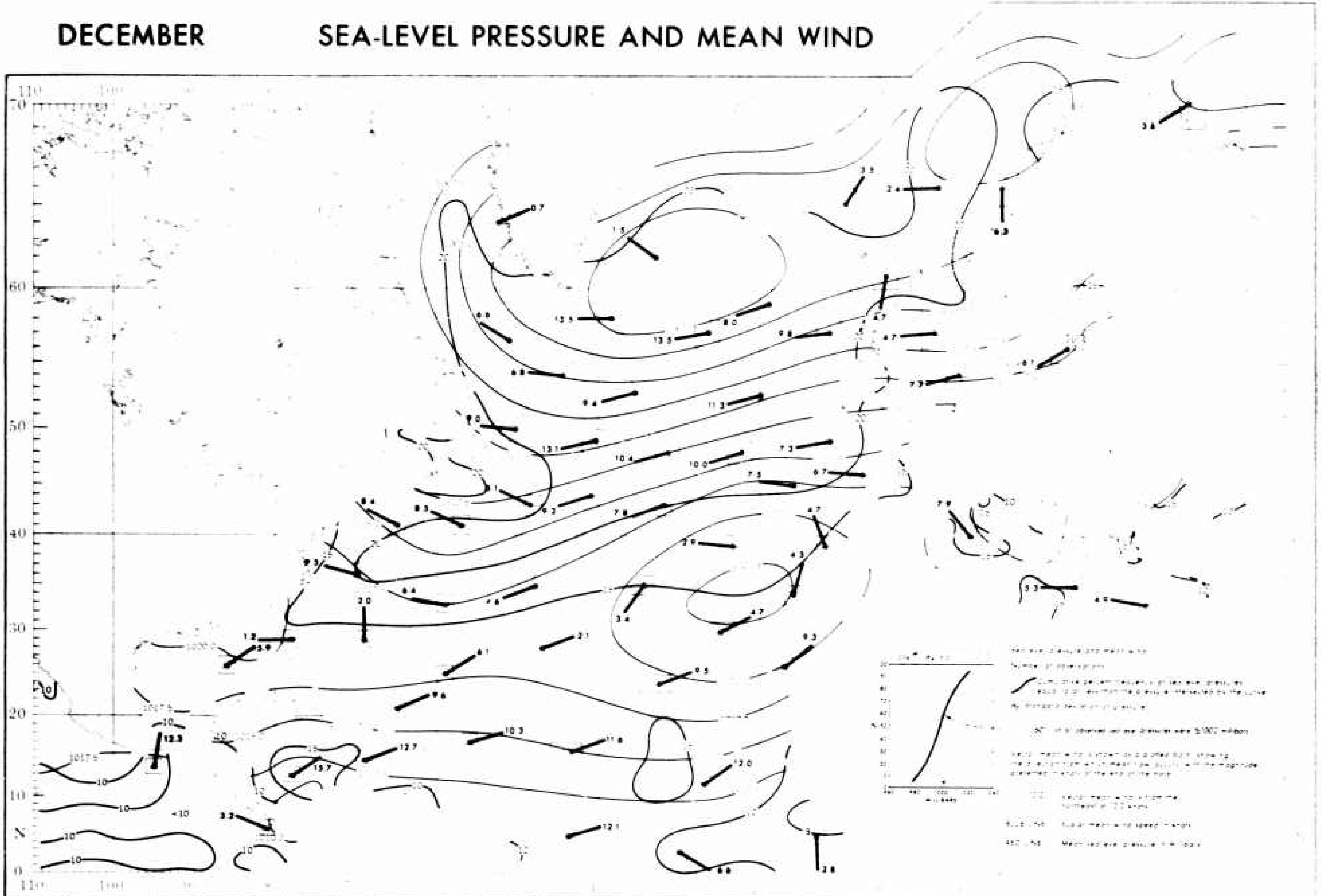


LOW CLOUD CEILING-VISIBILITY-WIND

DECEMBER

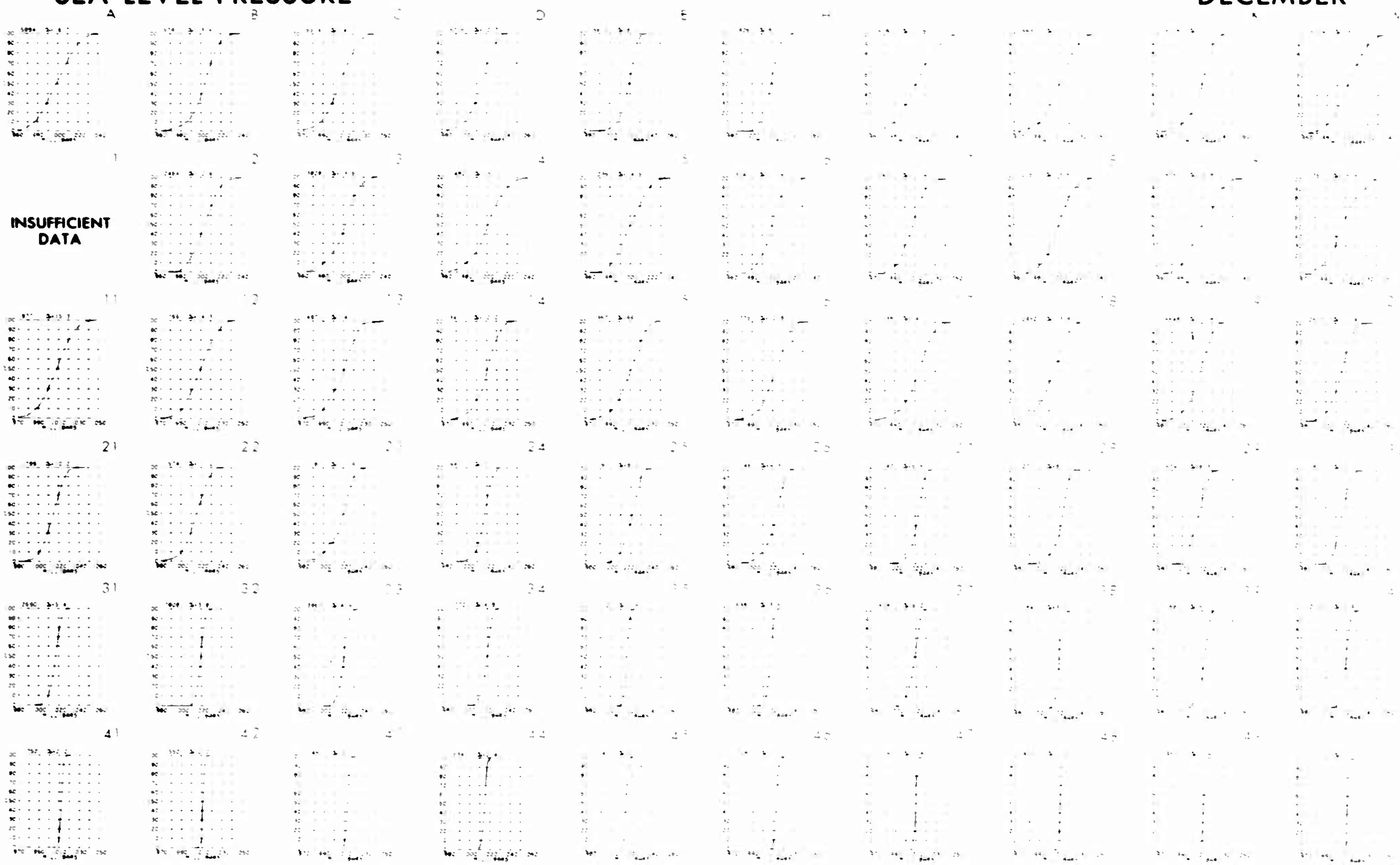


DECEMBER SEA-LEVEL PRESSURE AND MEAN WIND

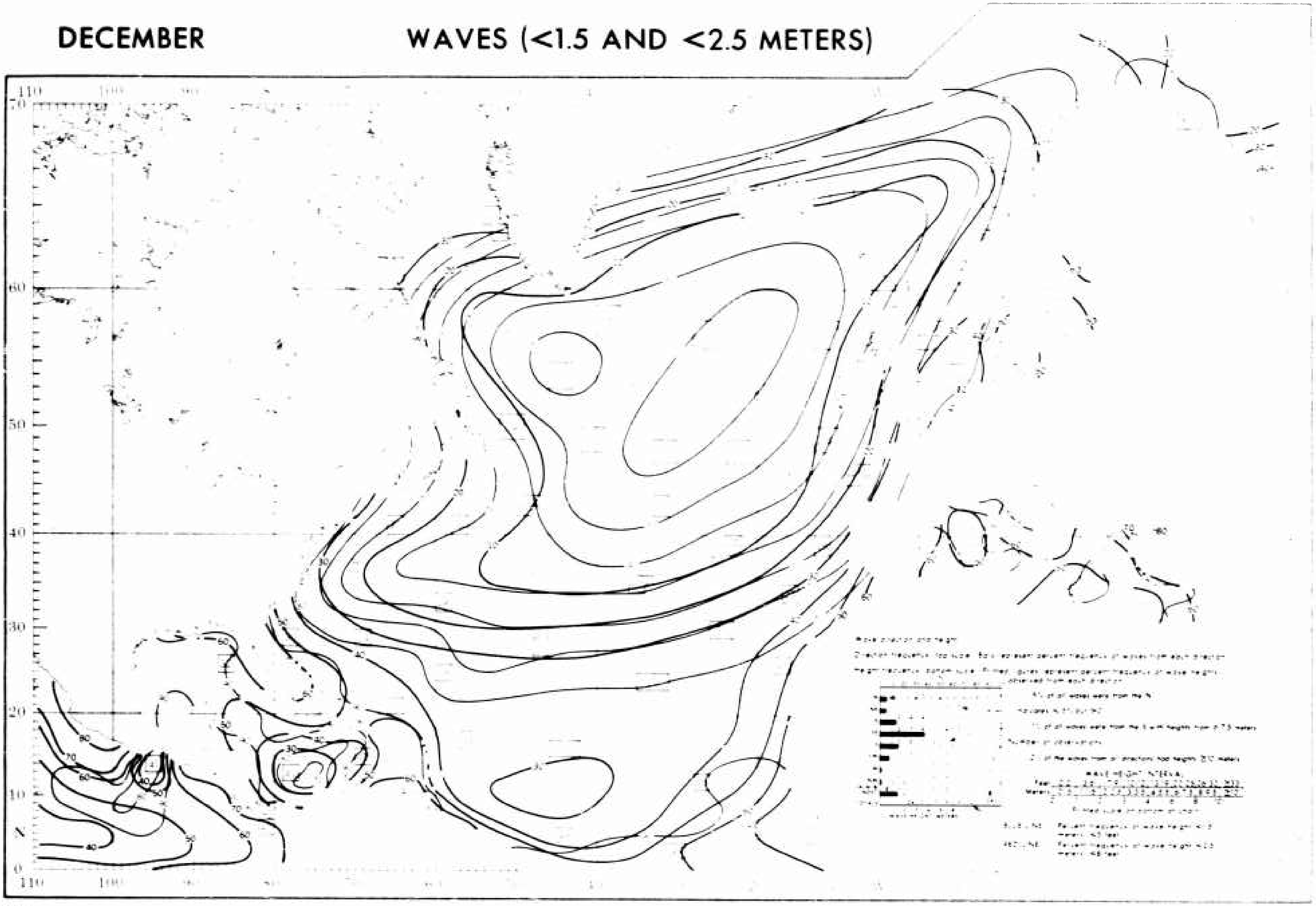


SEA LEVEL PRESSURE

DECEMBER

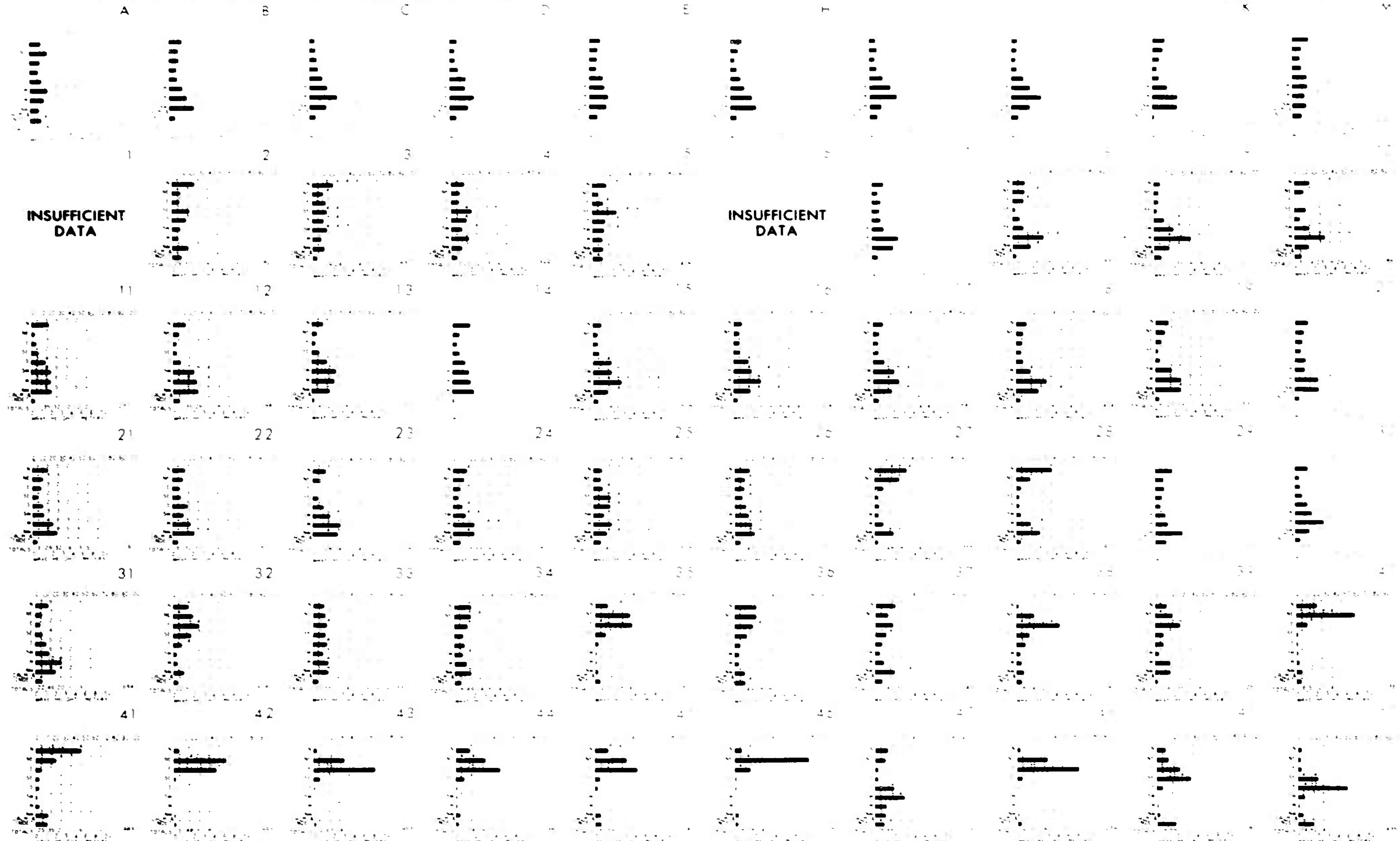


DECEMBER WAVES (<1.5 AND <2.5 METERS)



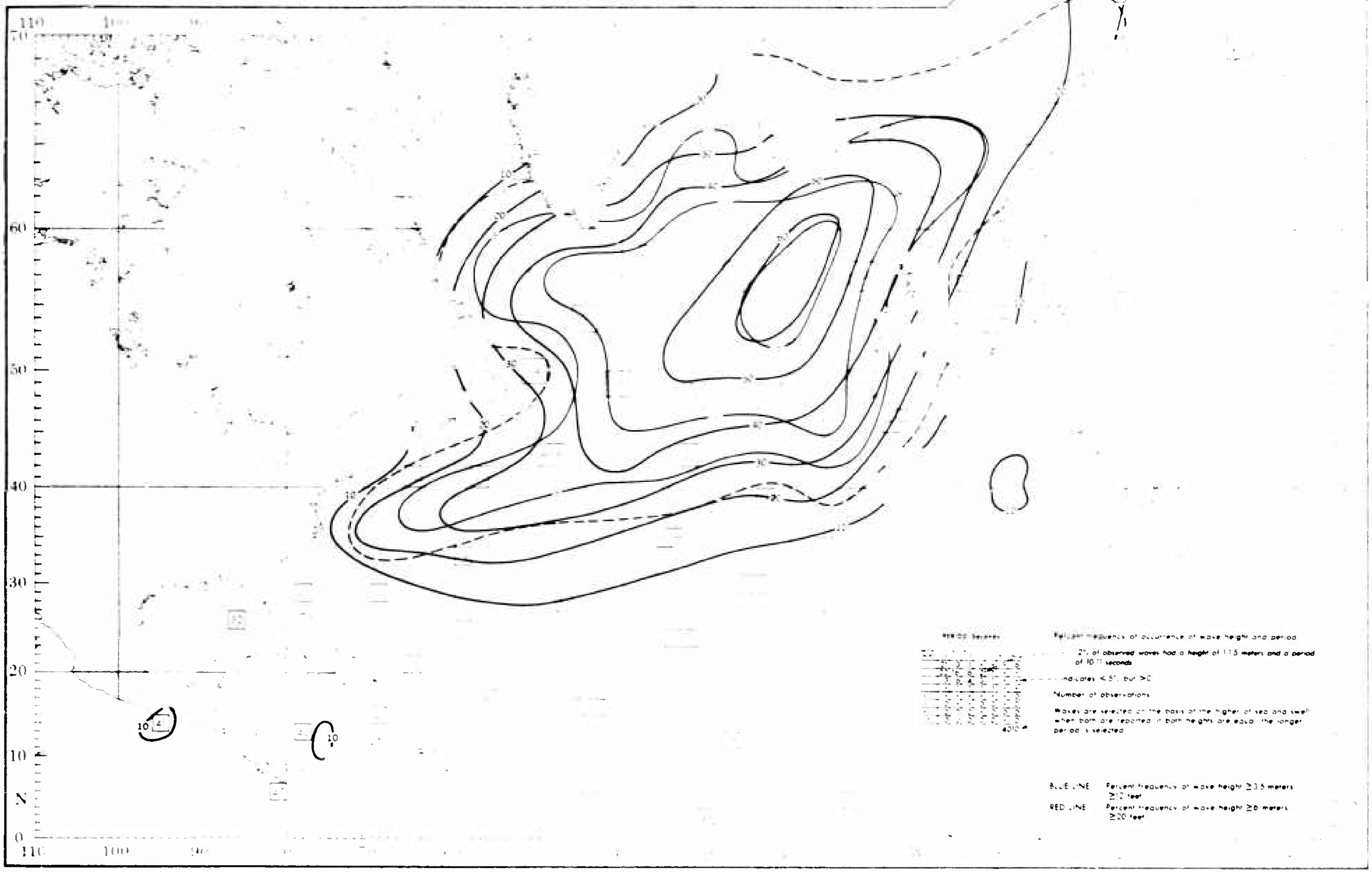
WAVE DIRECTION AND HEIGHT

DECEMBER



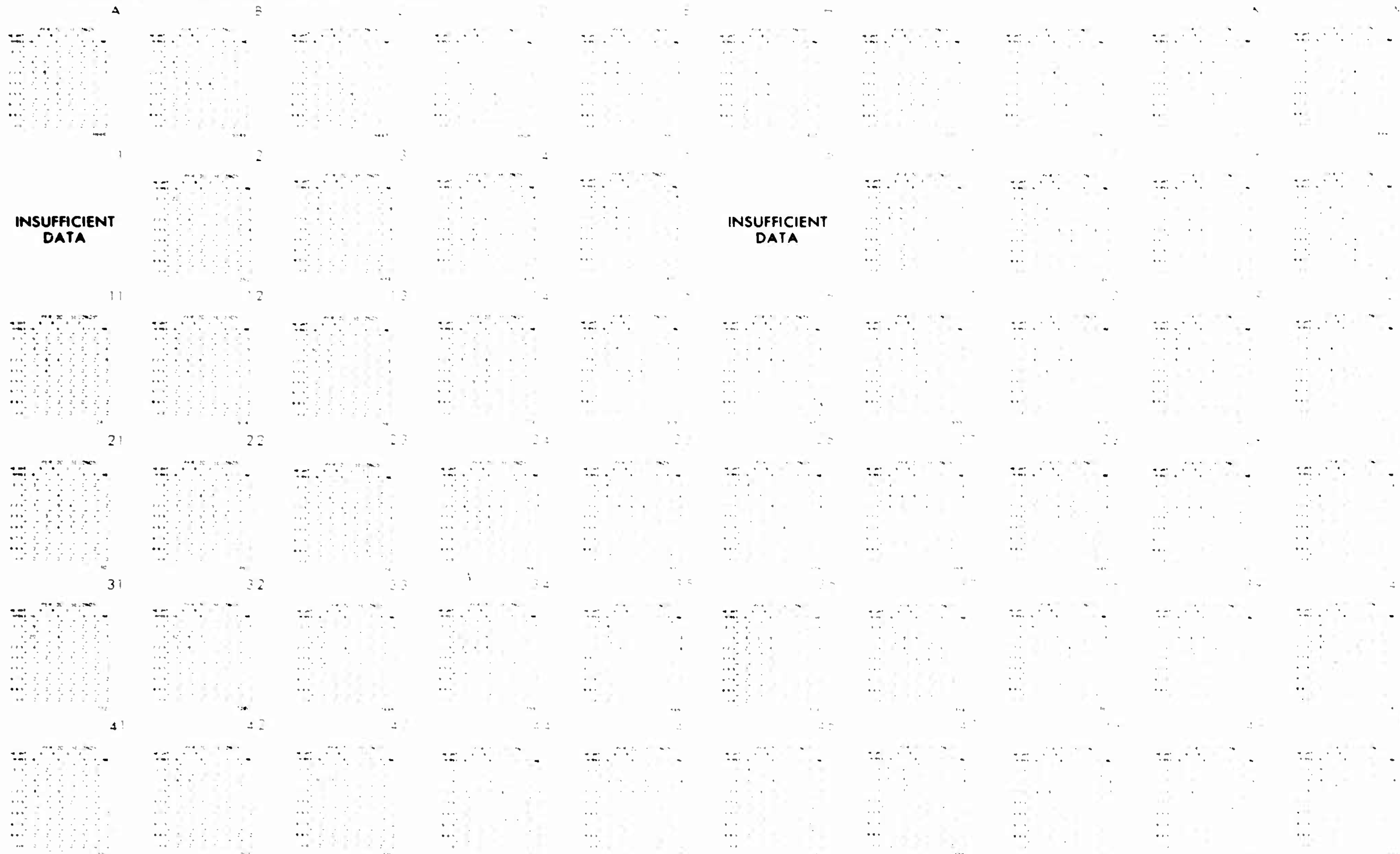
DECEMBER

WAVES (≥3.5 AND ≥6 METERS)

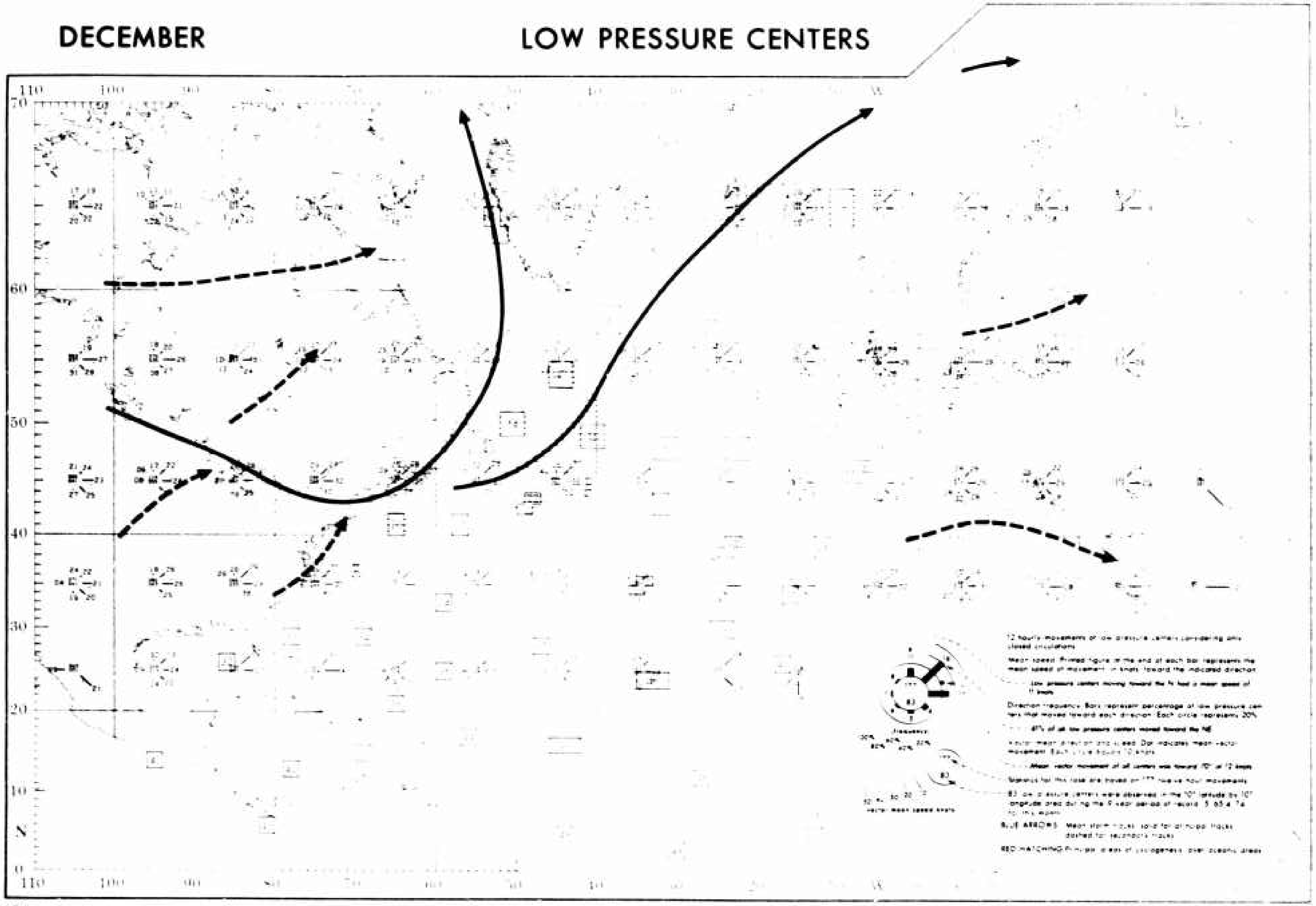


WAVE PERIOD AND HEIGHT

DECEMBER



DECEMBER LOW PRESSURE CENTERS



TROPICAL CYCLONE

DECEMBER

12 hourly movements of tropical cyclone centers with tropical storm intensity or greater wind speed estimated ≥34 knots

Mean speed. Printed figure at the end of each bar represents the mean speed of movement in knots toward the indicated direction.

Centers moving toward the N had a mean speed of 5 knots

Direction frequency. Bars represent percentage frequency of centers that moved toward each direction. Each circle represents 20%.

35% of all tropical cyclones moved toward the NE

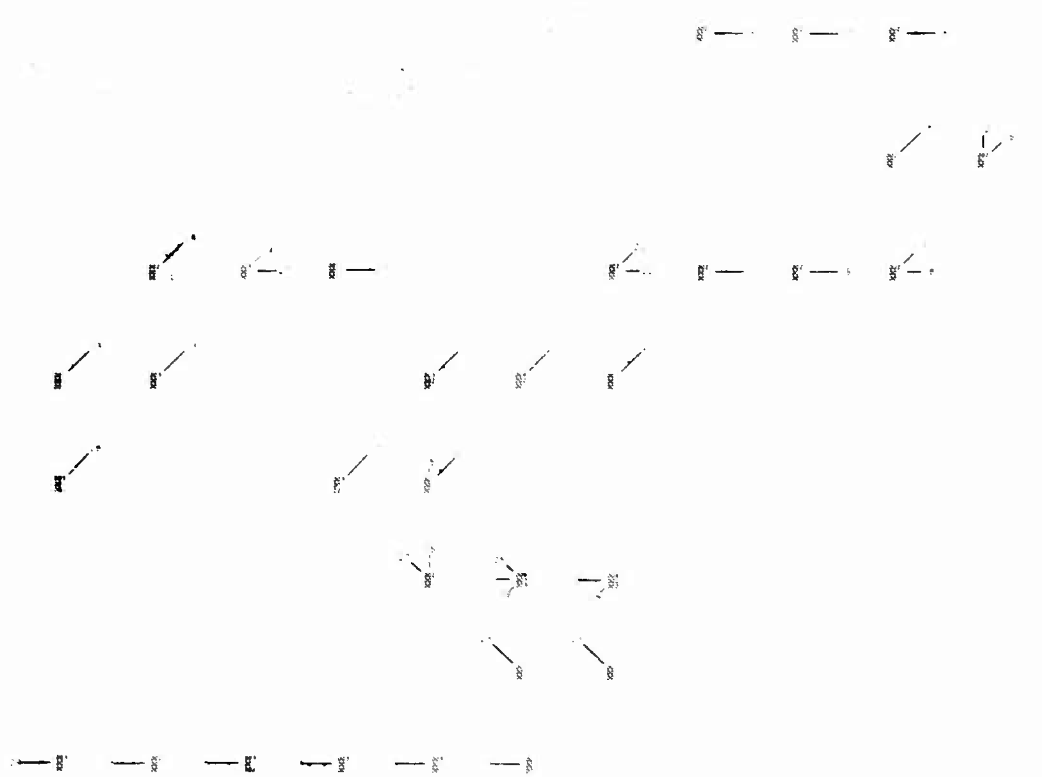
Vector mean direction and speed. Dot indicates mean vector movement. Each circle equals 10 knots.

Mean vector movement of all centers was toward 75° at 7 knots

Statistics for this rose are based on 277 twelve hour movements.

50 individual storms were observed in the 5° x 5° area during the period of record.

Probability of having at least one tropical cyclone in this area in any given year for this month is 26%.



PART II OCEANOGRAPHY

FIG. 1 MEAN SURFACE CURRENT SPEEDS (KNOTS) AND PREVAILING DIRECTIONS, WINTER (JANUARY, FEBRUARY, MARCH)

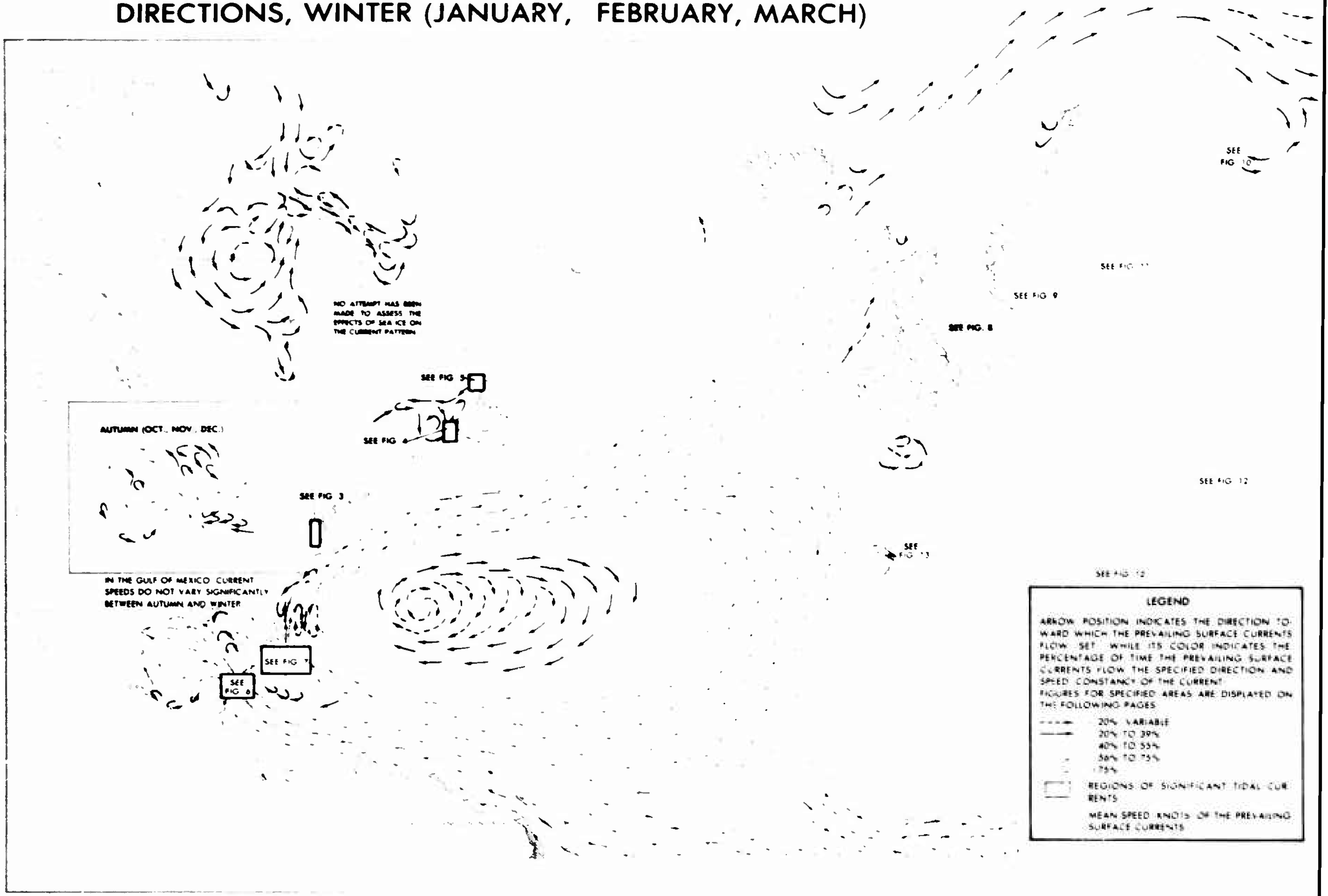


FIG. 2 MEAN SURFACE CURRENT SPEEDS (KNOTS) AND PREVAILING DIRECTIONS, SUMMER (JULY, AUGUST, SEPTEMBER)

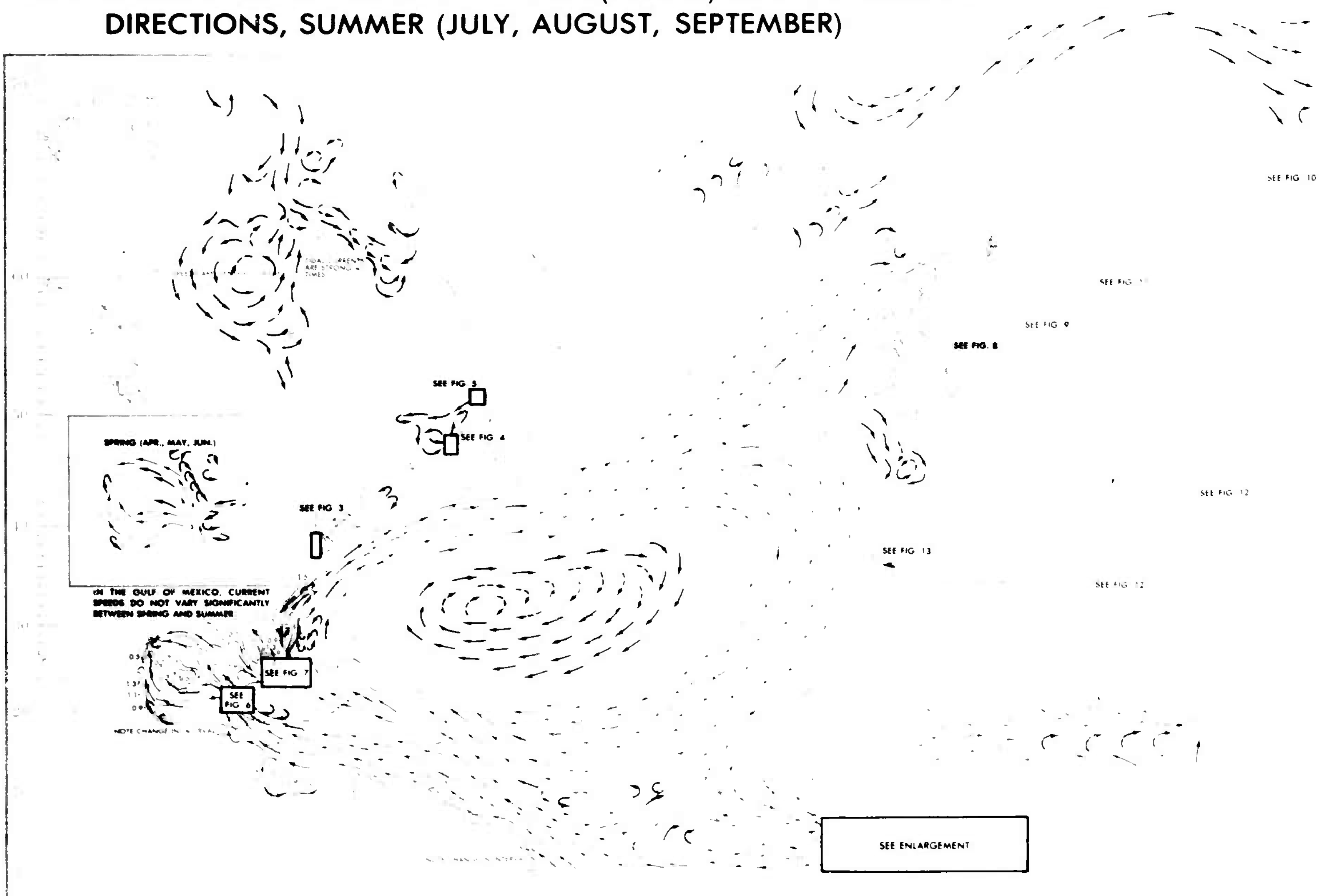
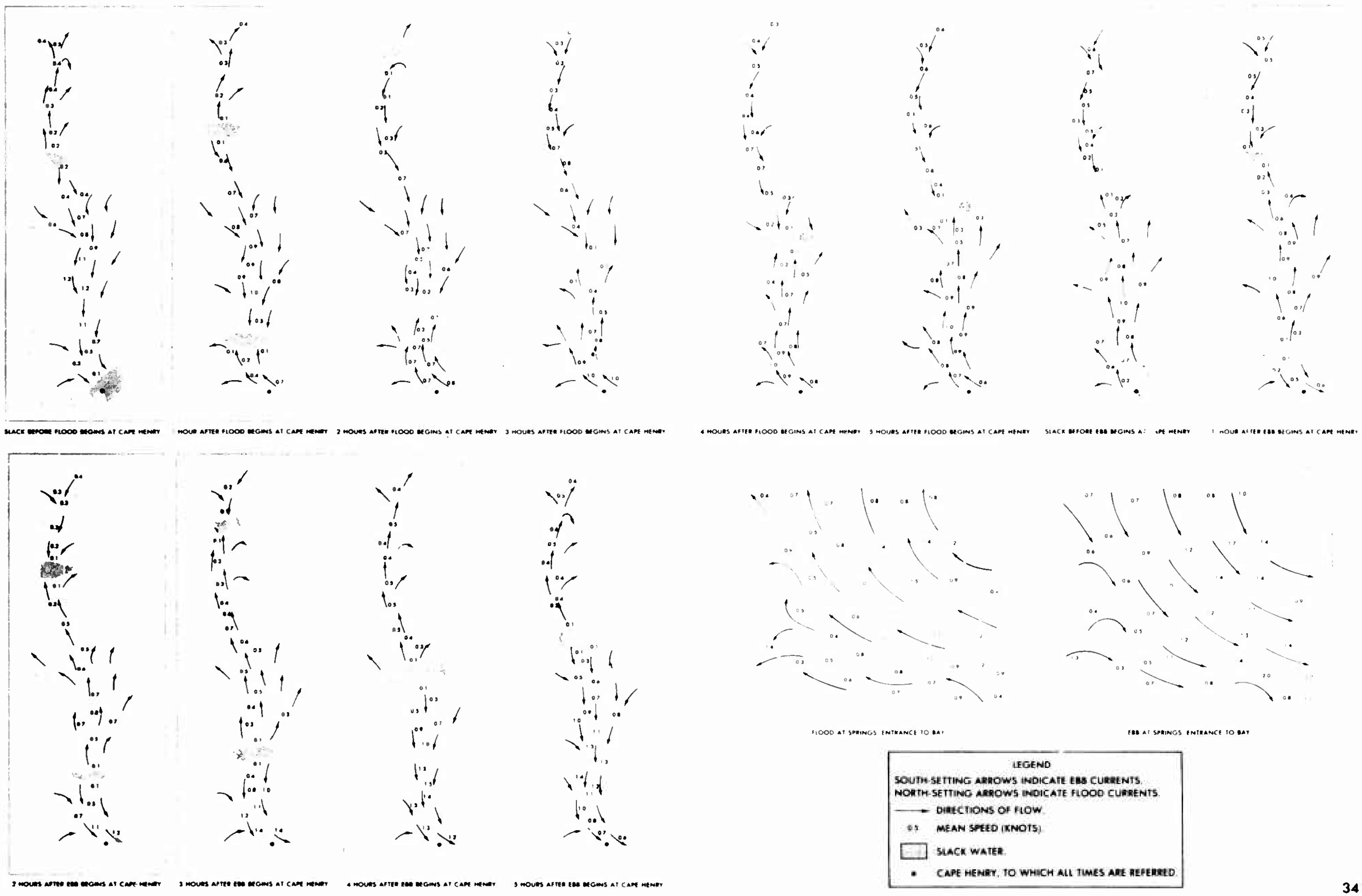


FIG. 3 SURFACE TIDAL CURRENTS AT SPRINGS, CHESAPEAKE BAY



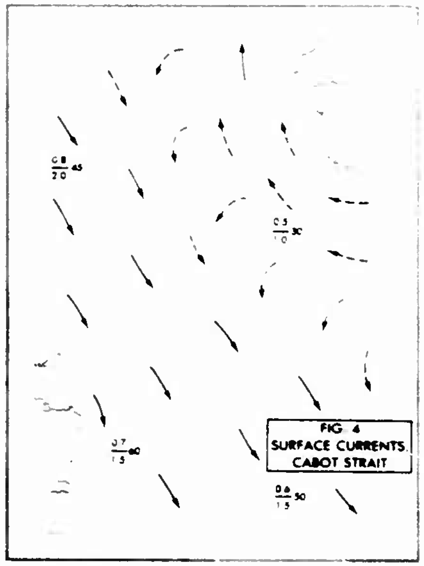


FIG. 4
SURFACE CURRENTS
CABOT STRAIT

LEGEND

- PREVAILING CURRENT. FLOOD CURRENT IN STRAIT OF BELLE ISLE. EBB SETS IN OPPOSITE DIRECTION
- PROBABLE CURRENT
- TIDAL CURRENTS PREDOMINATING
- MEAN AXIS OF FLORIDA CURRENT
- 1.5 MEAN SPEED KNOTS
- 90 PERCENT FREQUENCY OF SET
- 5.0 MAXIMUM SPEED KNOTS

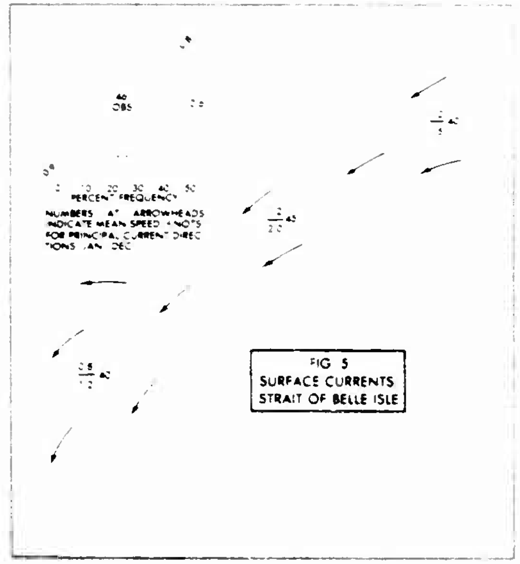


FIG. 5
SURFACE CURRENTS
STRAIT OF BELLE ISLE

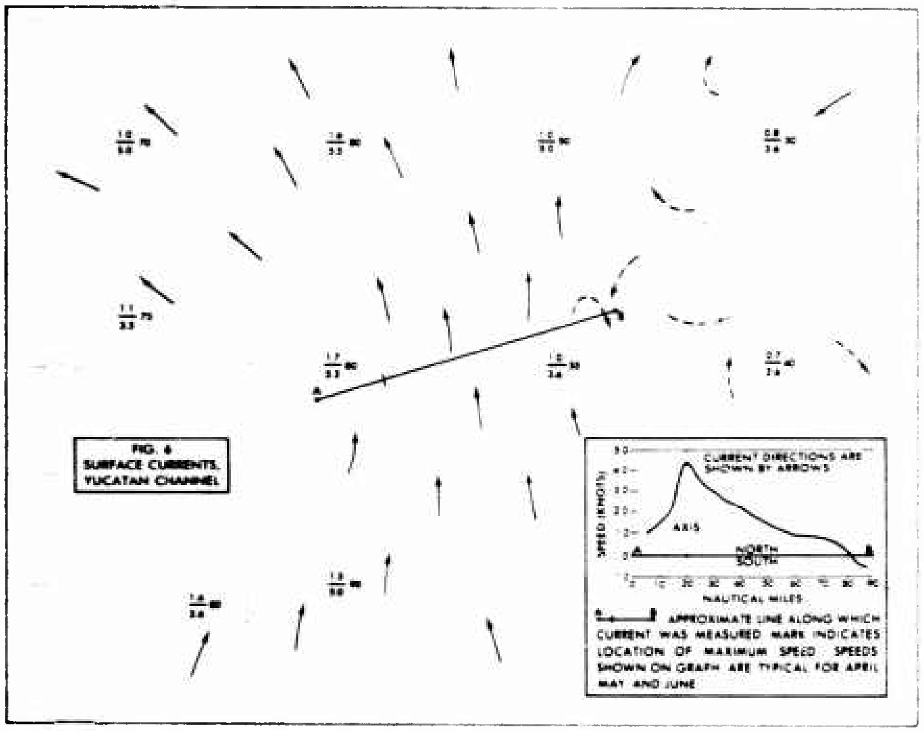


FIG. 6
SURFACE CURRENTS,
YUCATAN CHANNEL

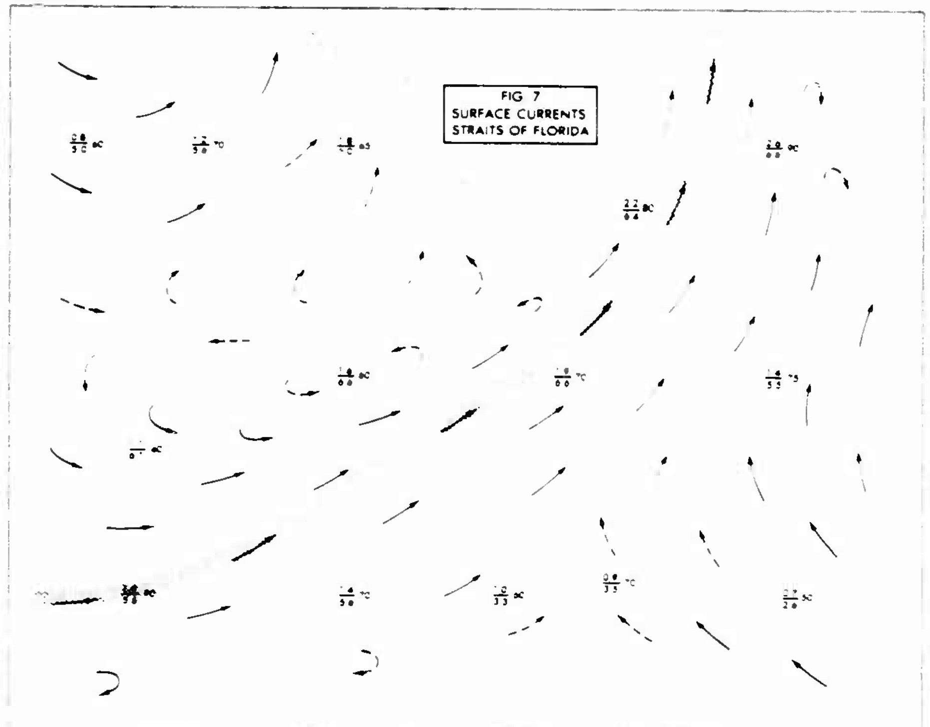
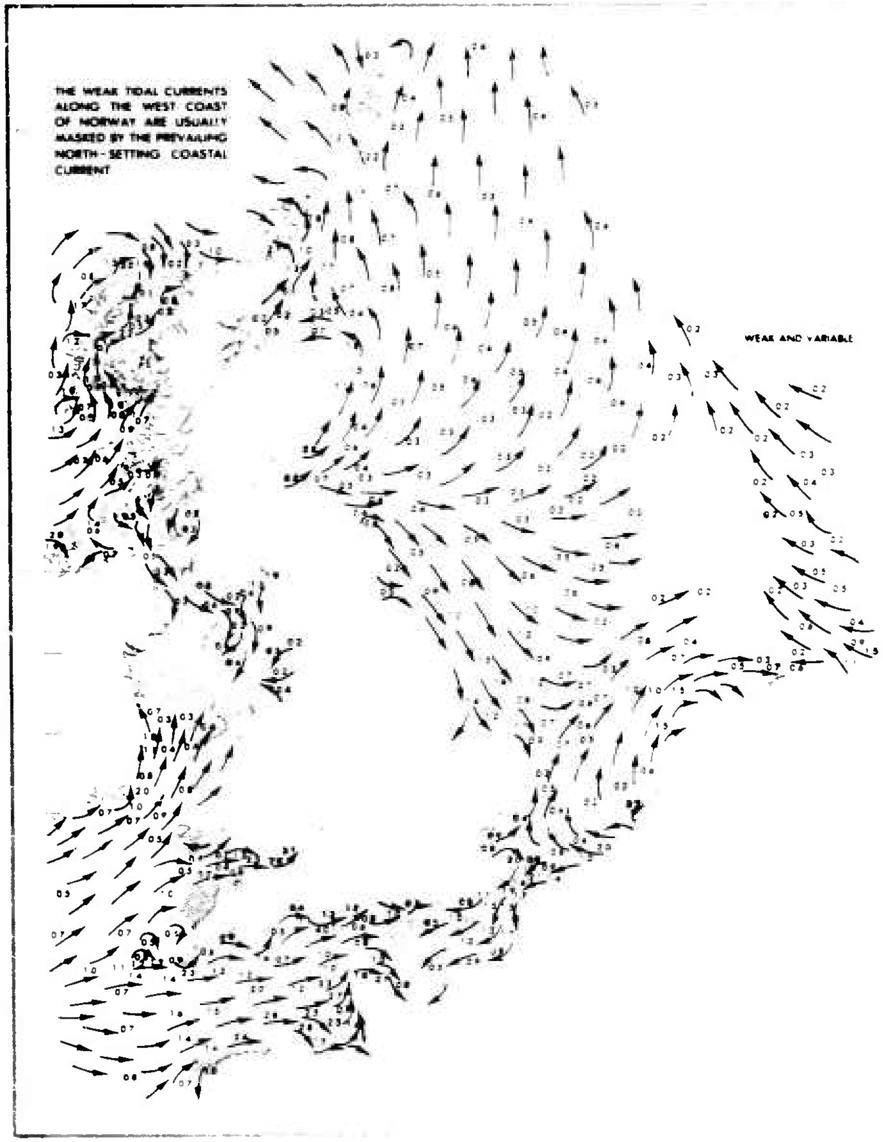
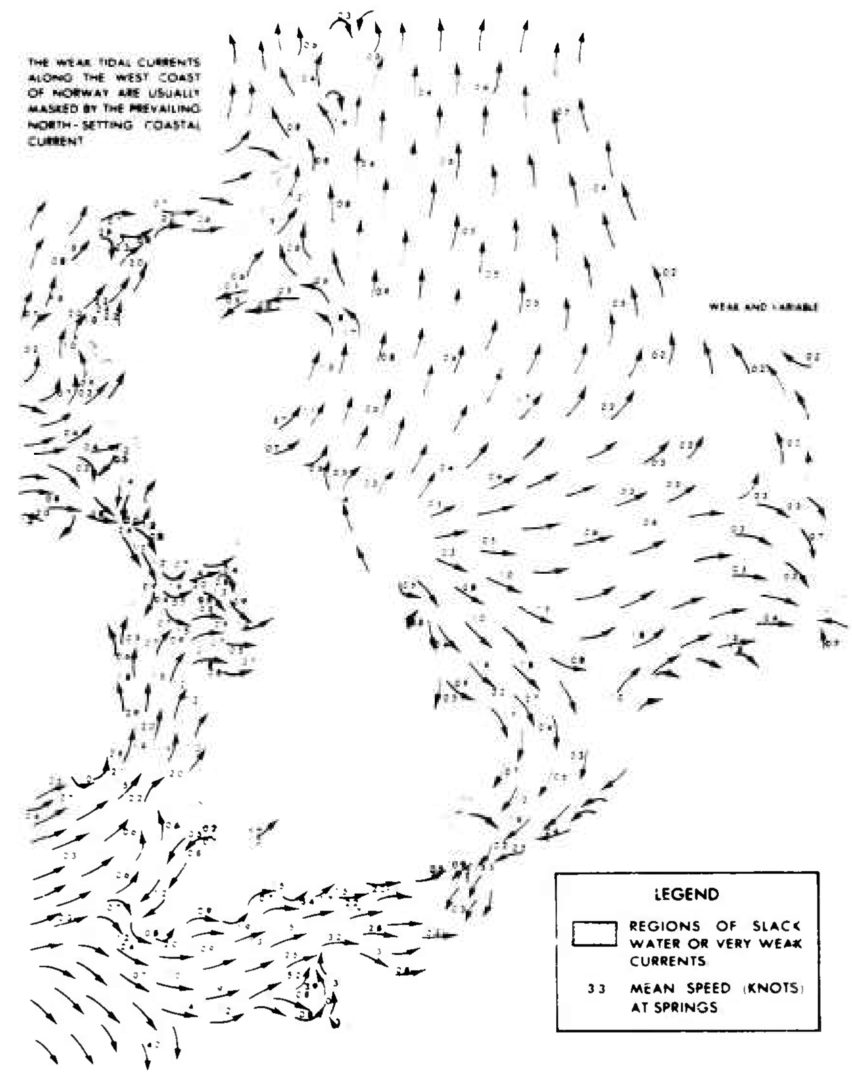


FIG. 7
SURFACE CURRENTS
STRAITS OF FLORIDA

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA

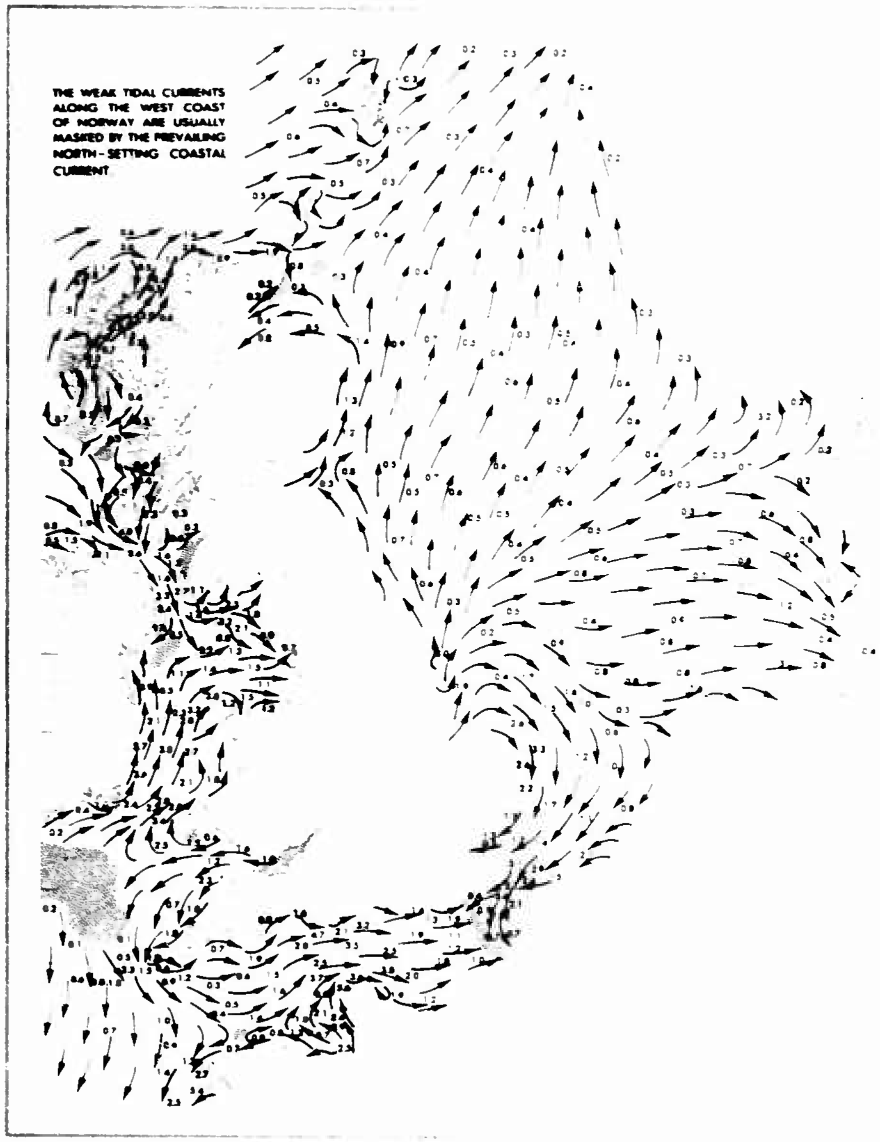


6 HOURS BEFORE HIGH WATER AT DOVER

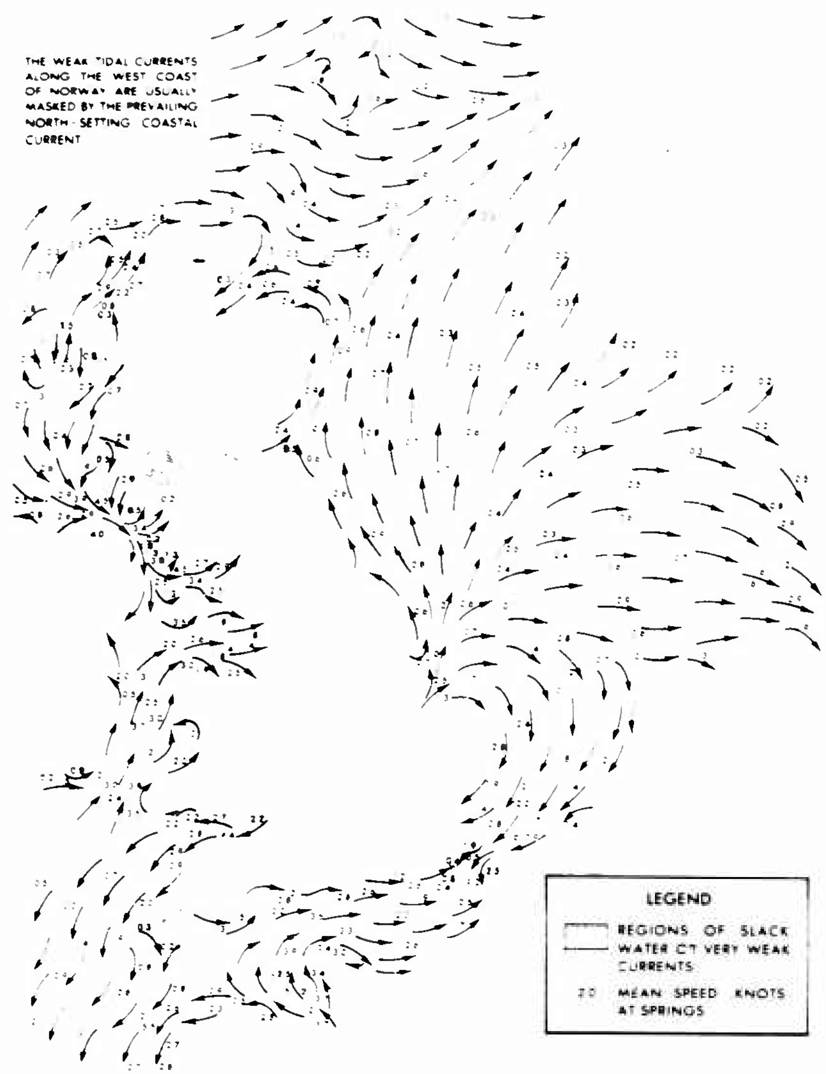


5 HOURS BEFORE HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)

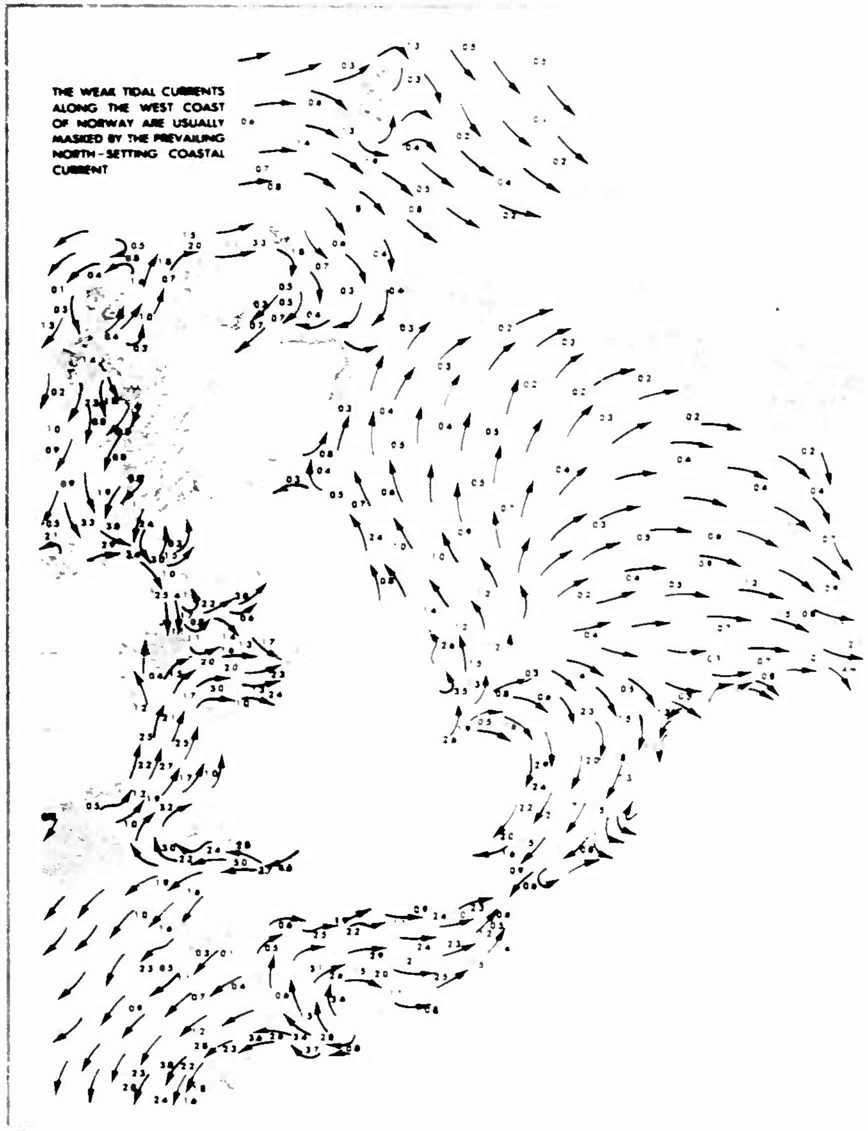


4 HOURS BEFORE HIGH WATER AT DOVER

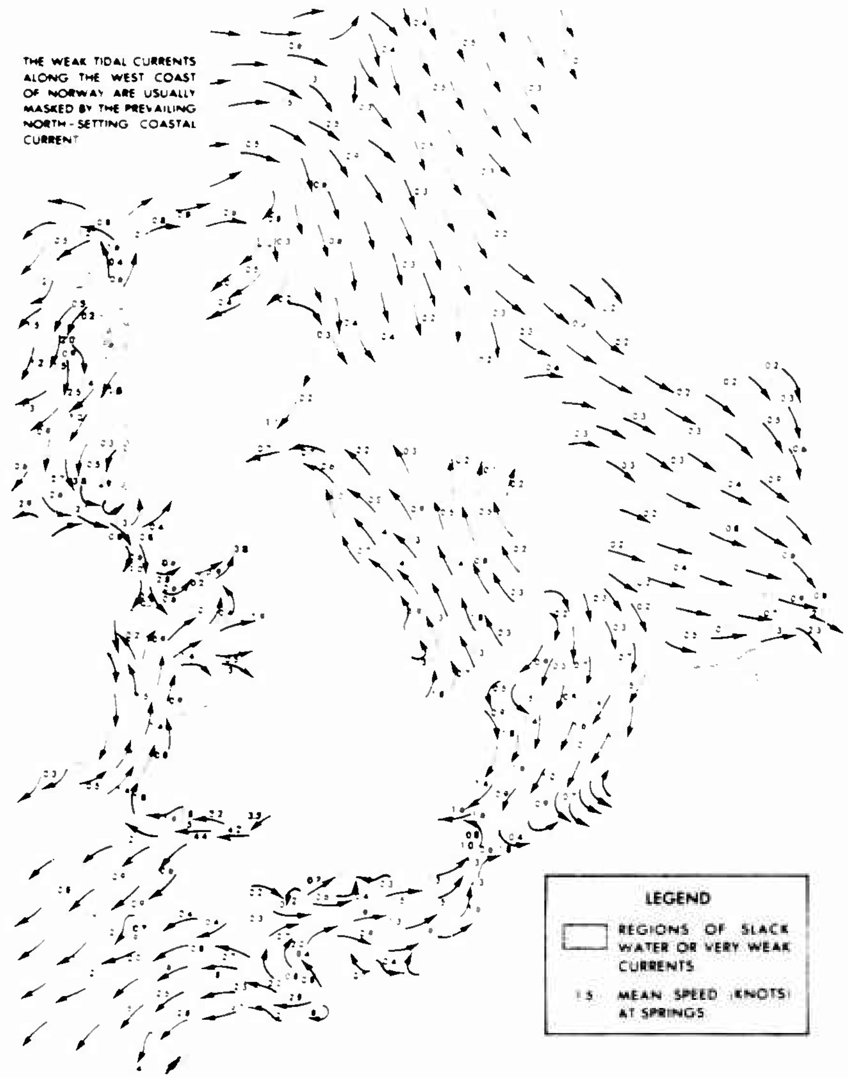


3 HOURS BEFORE HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)

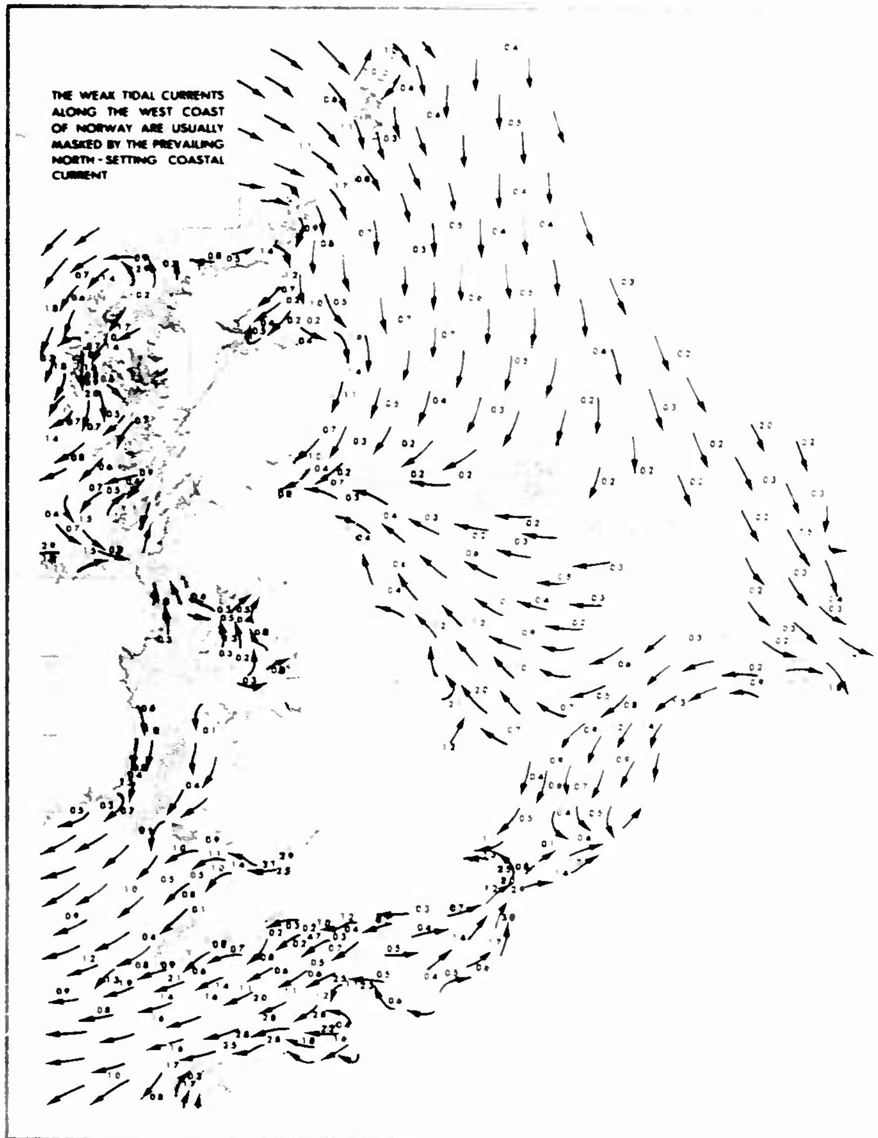


2 HOURS BEFORE HIGH WATER AT DOVER

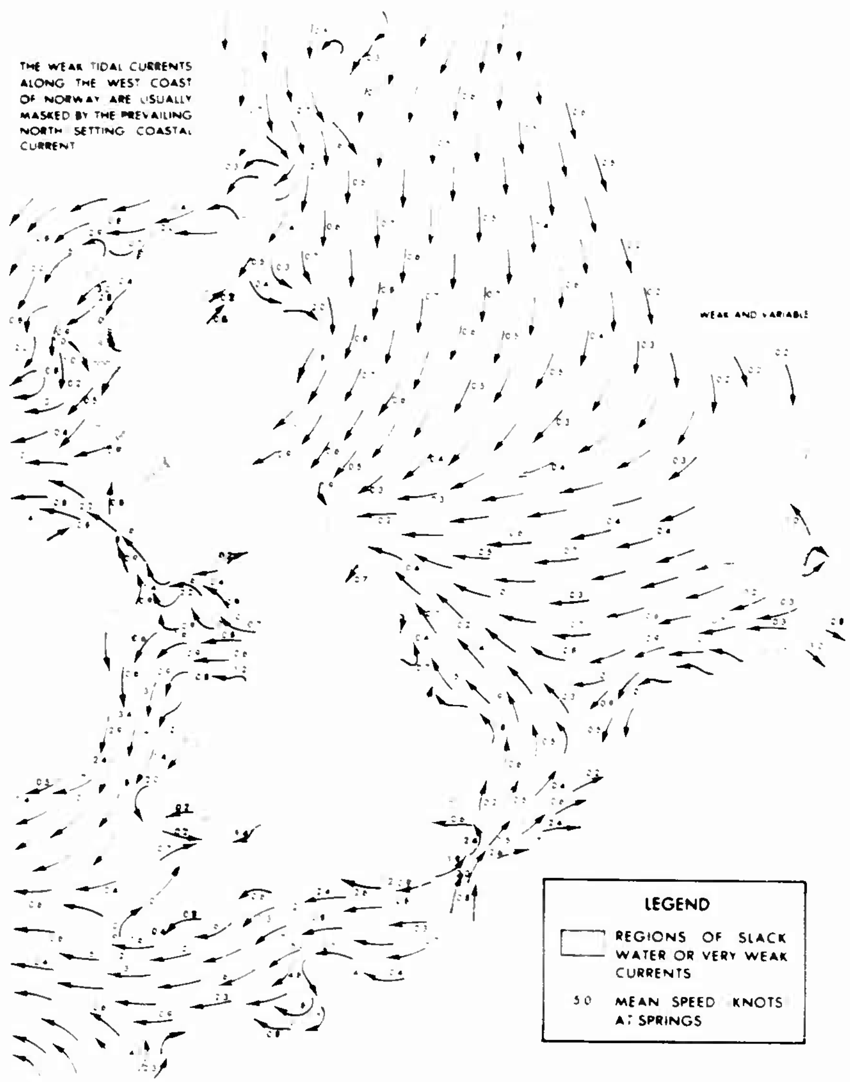


1 HOUR BEFORE HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)

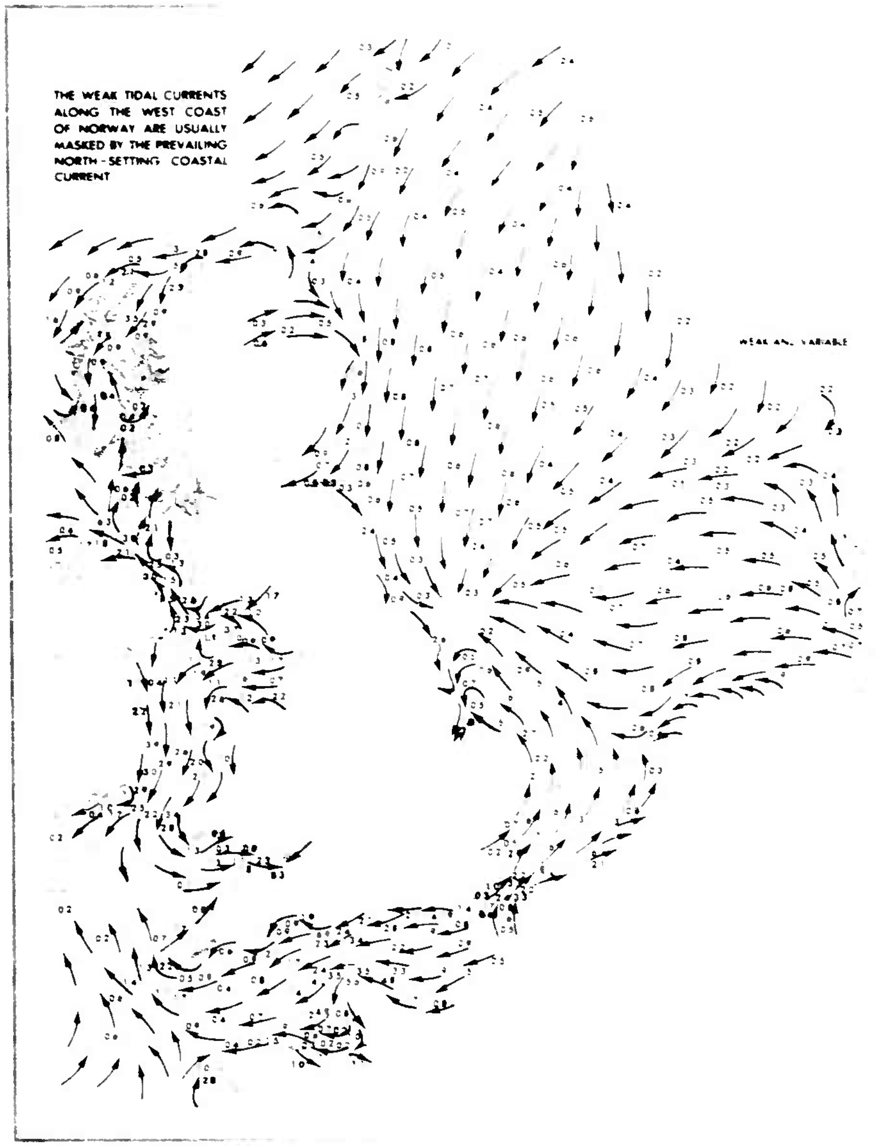


HIGH WATER AT DOVER

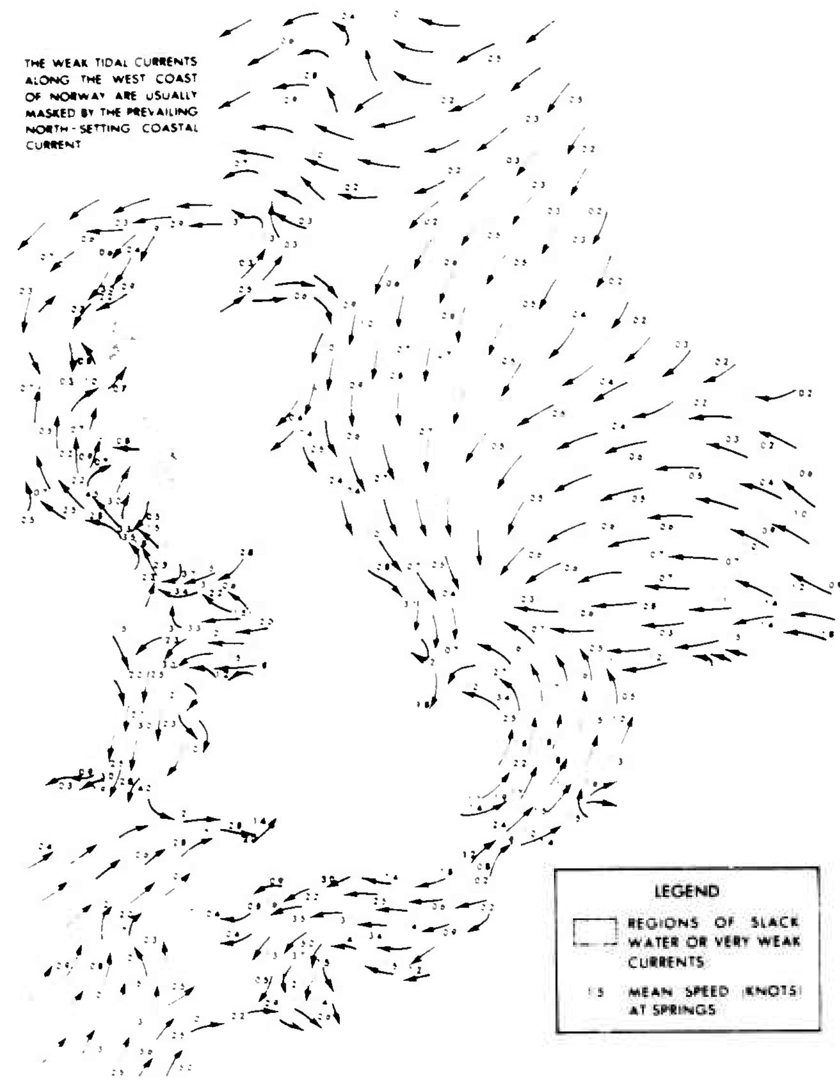


1 HOUR AFTER HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)

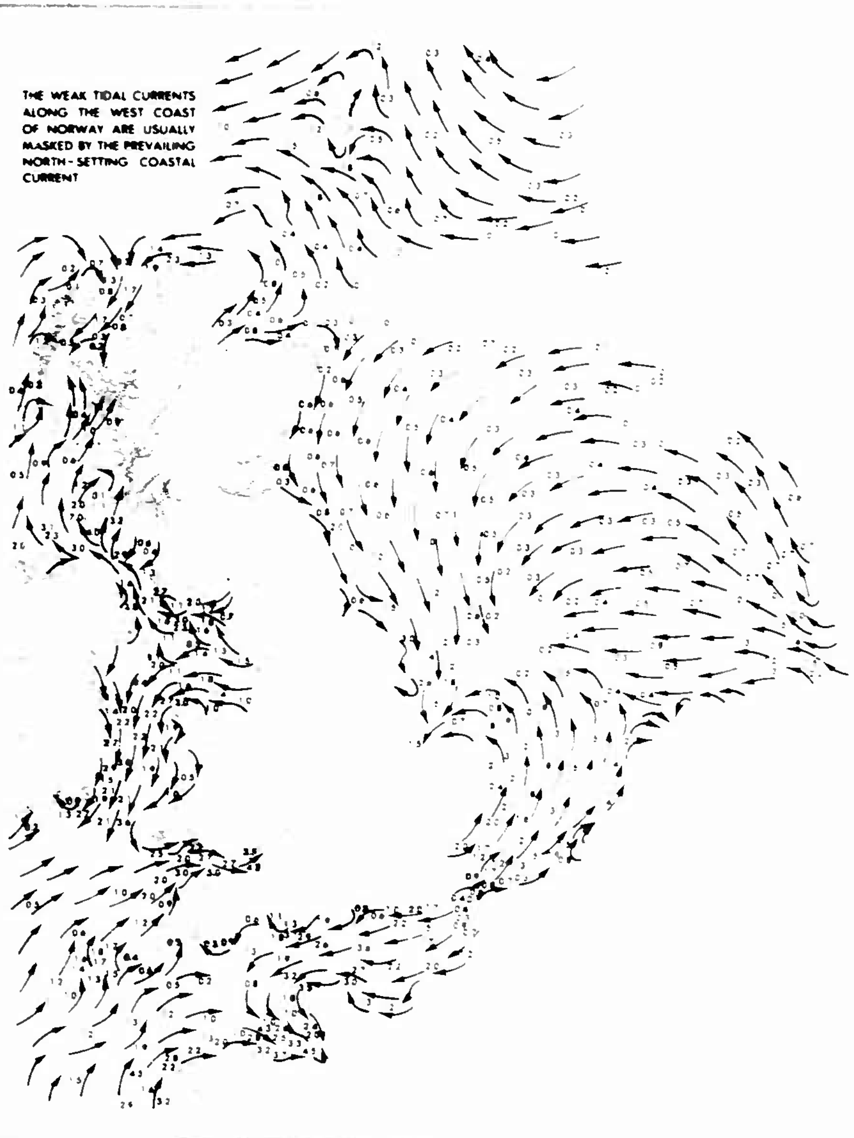


2 HOURS AFTER HIGH WATER AT DOVER

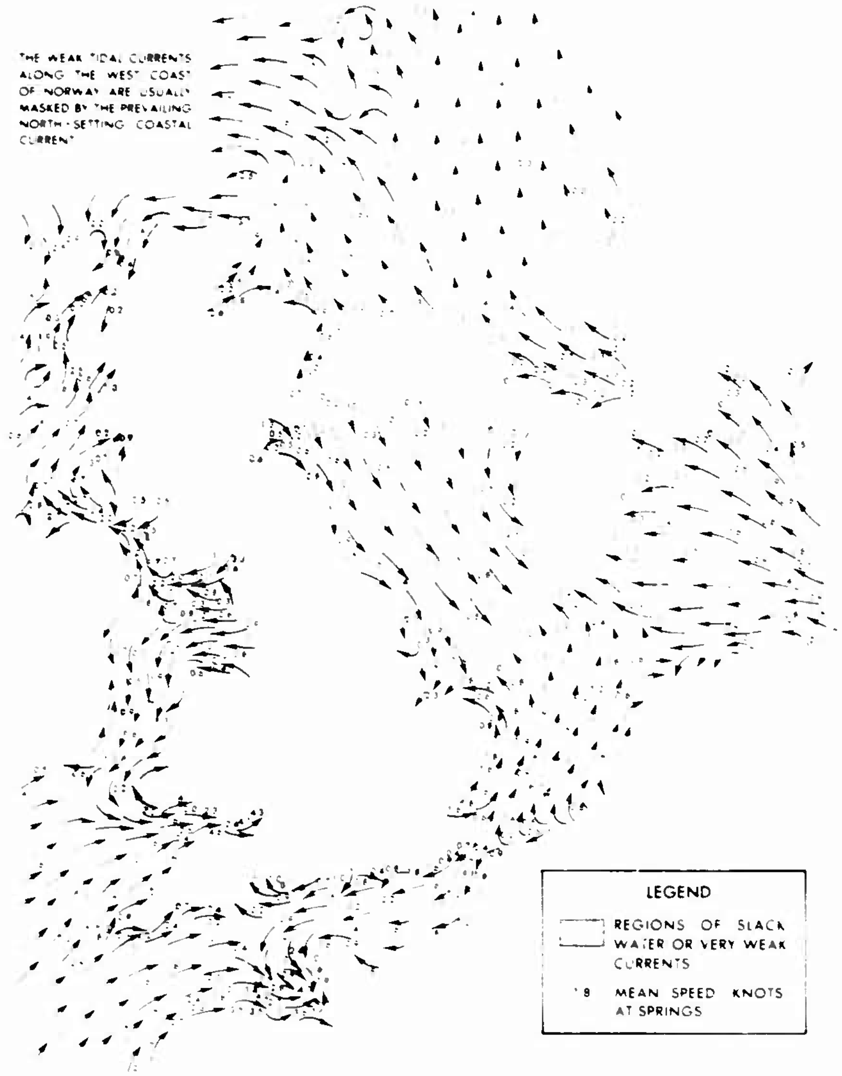


3 HOURS AFTER HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)

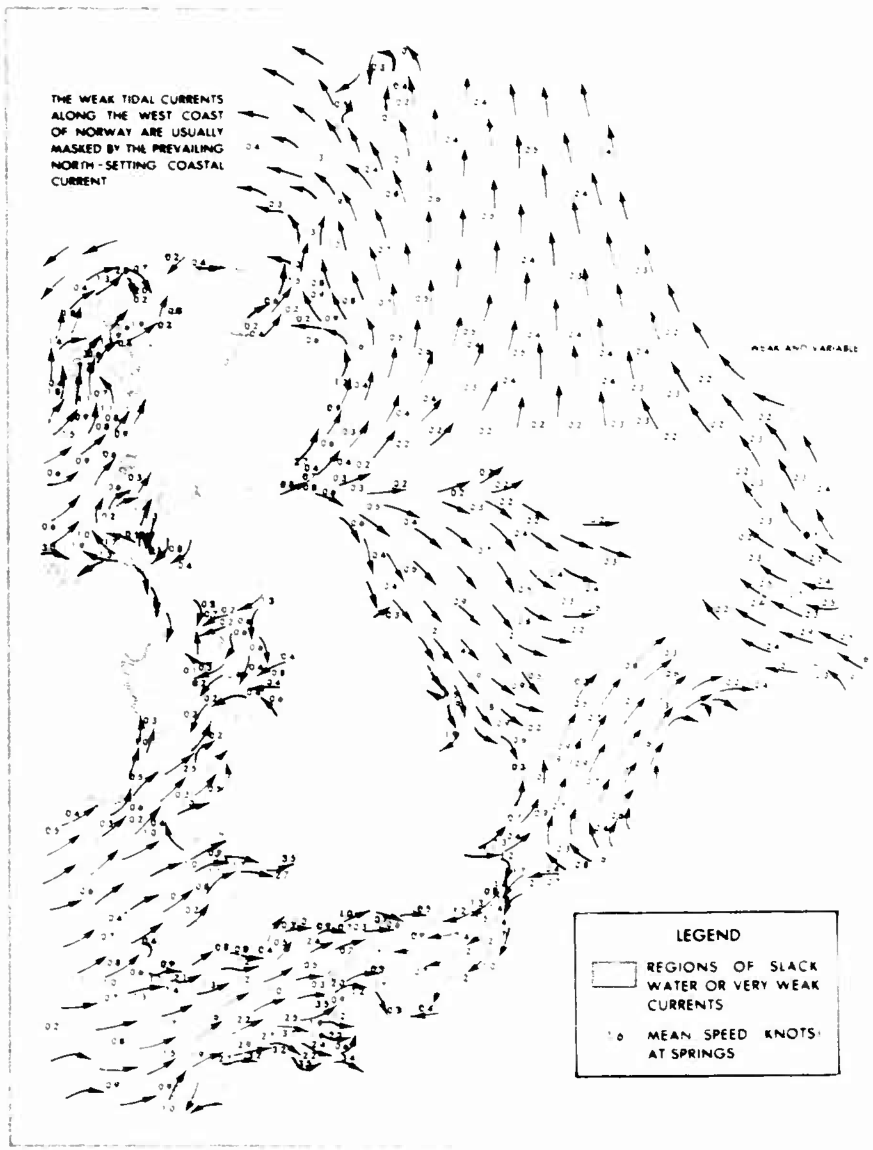


4 HOURS AFTER HIGH WATER AT DOVER



5 HOURS AFTER HIGH WATER AT DOVER

FIG. 8 TIDAL CURRENTS, BRITISH ISLES AND NORTH SEA (Cont'd)



6 HOURS AFTER HIGH WATER AT DOVER

FIG. 9 SURFACE CURRENTS IN THE SKAGERRA[K] KATTEGAT, THE SOUND, AND BELTS

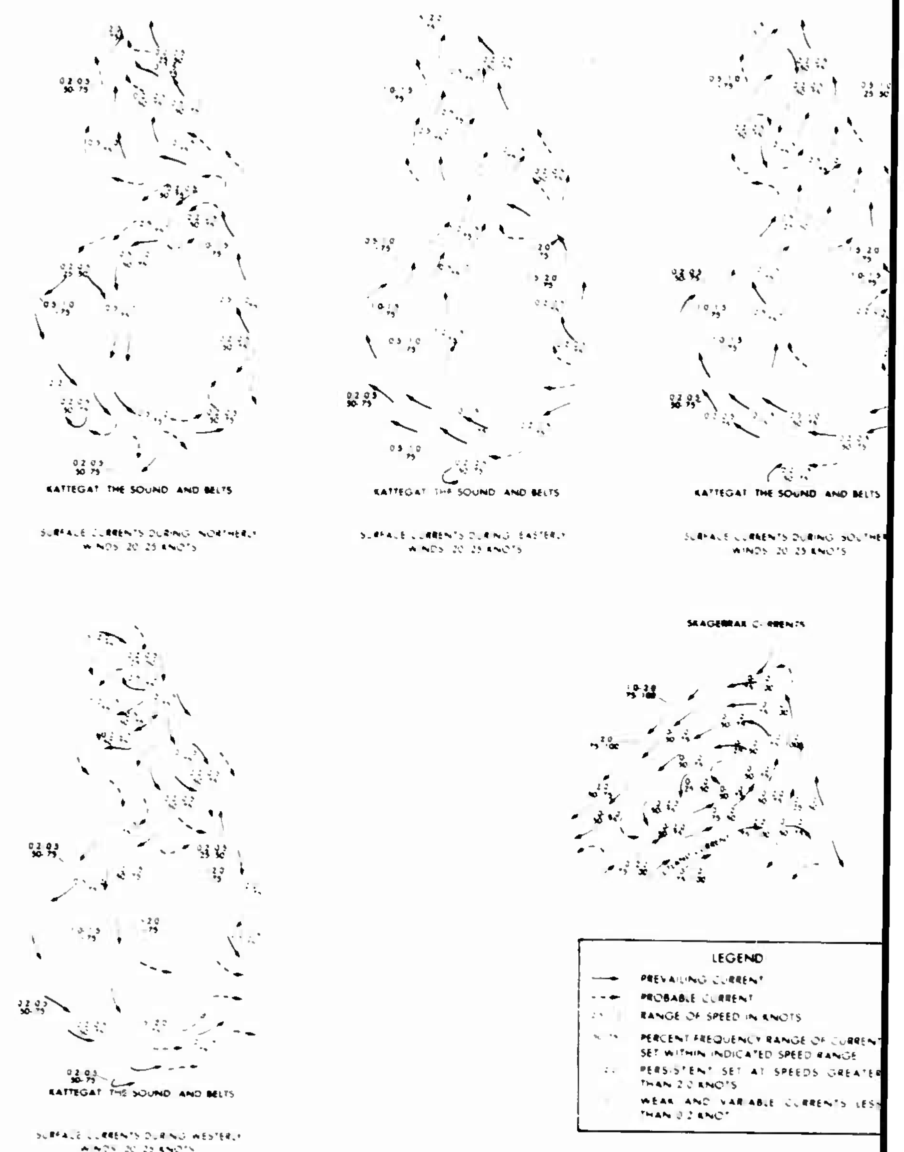


FIG. 10 TIDAL CURRENTS IN THE ENTRANCE TO THE WHITE SEA

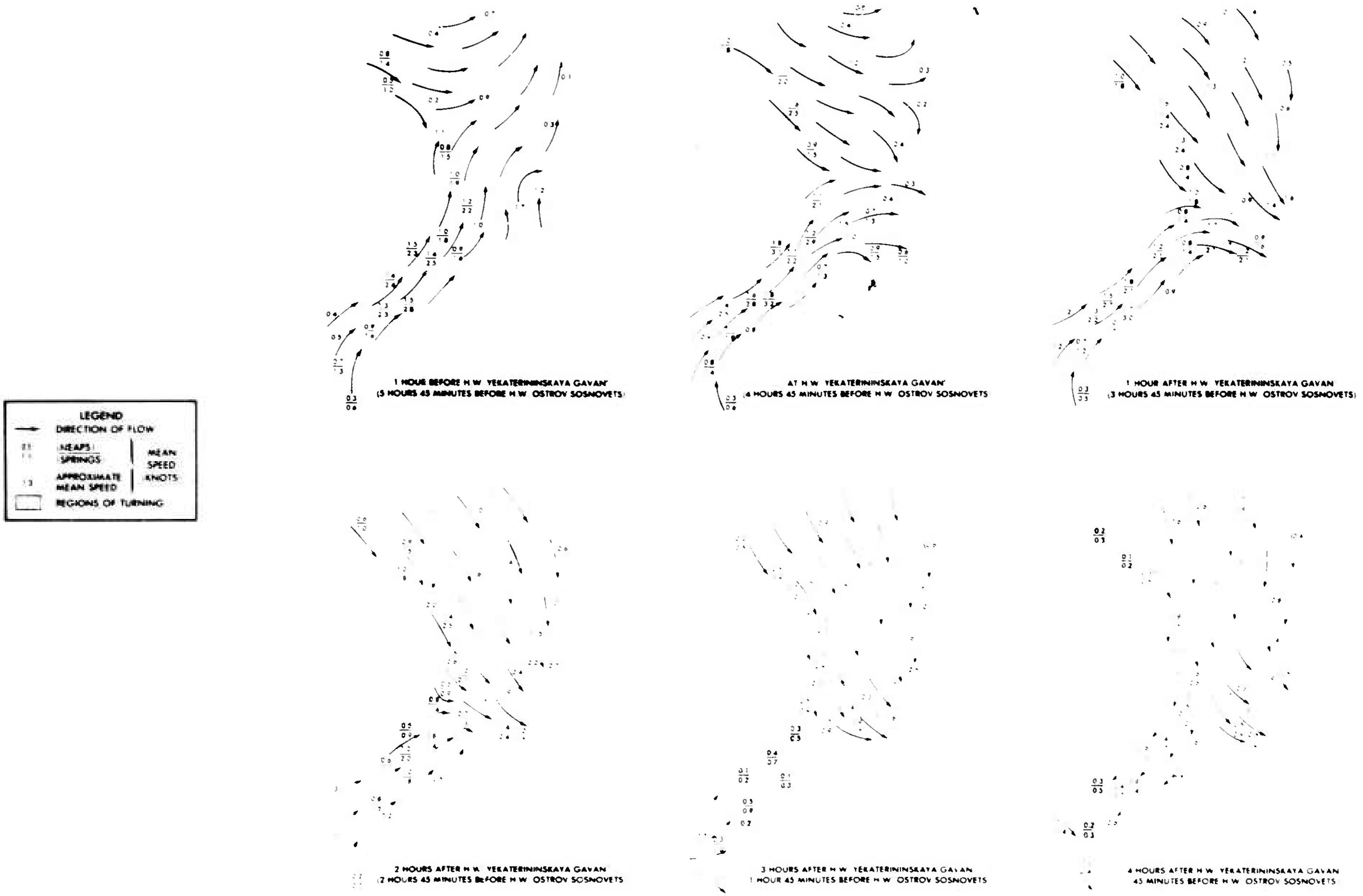


FIG. 10 TIDAL CURRENTS IN THE ENTRANCE TO THE WHITE SEA (Cont'd)

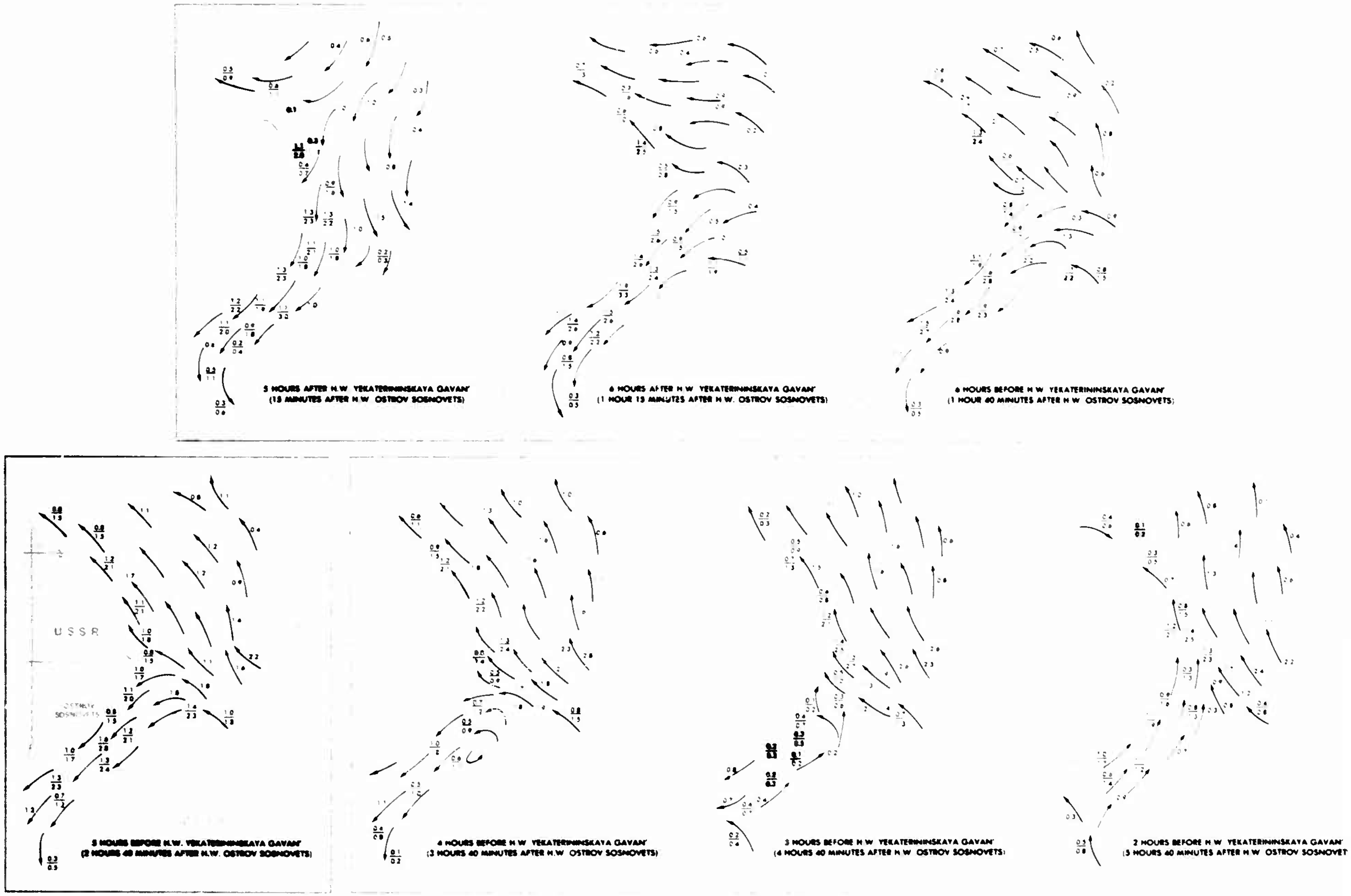
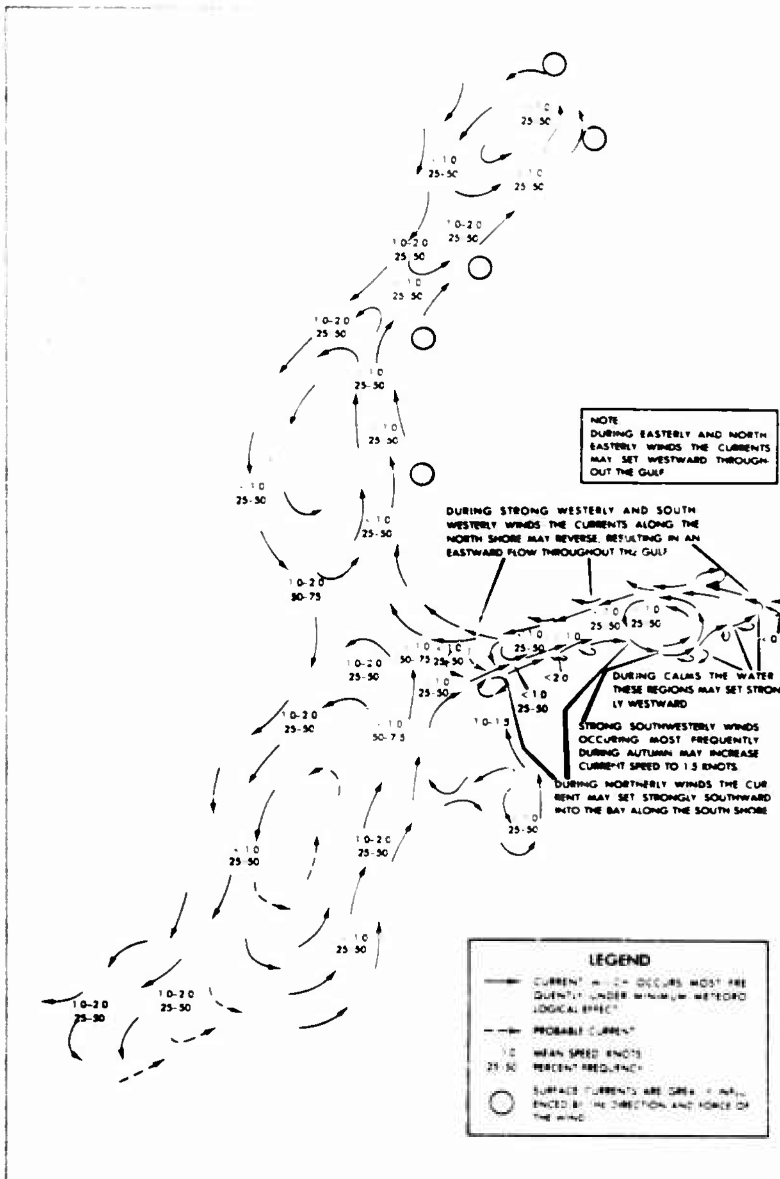


FIG. 11 GENERAL SURFACE CURRENTS, BALTIC SEA, GULF OF BOTHNIA, AND GULF OF FINLAND



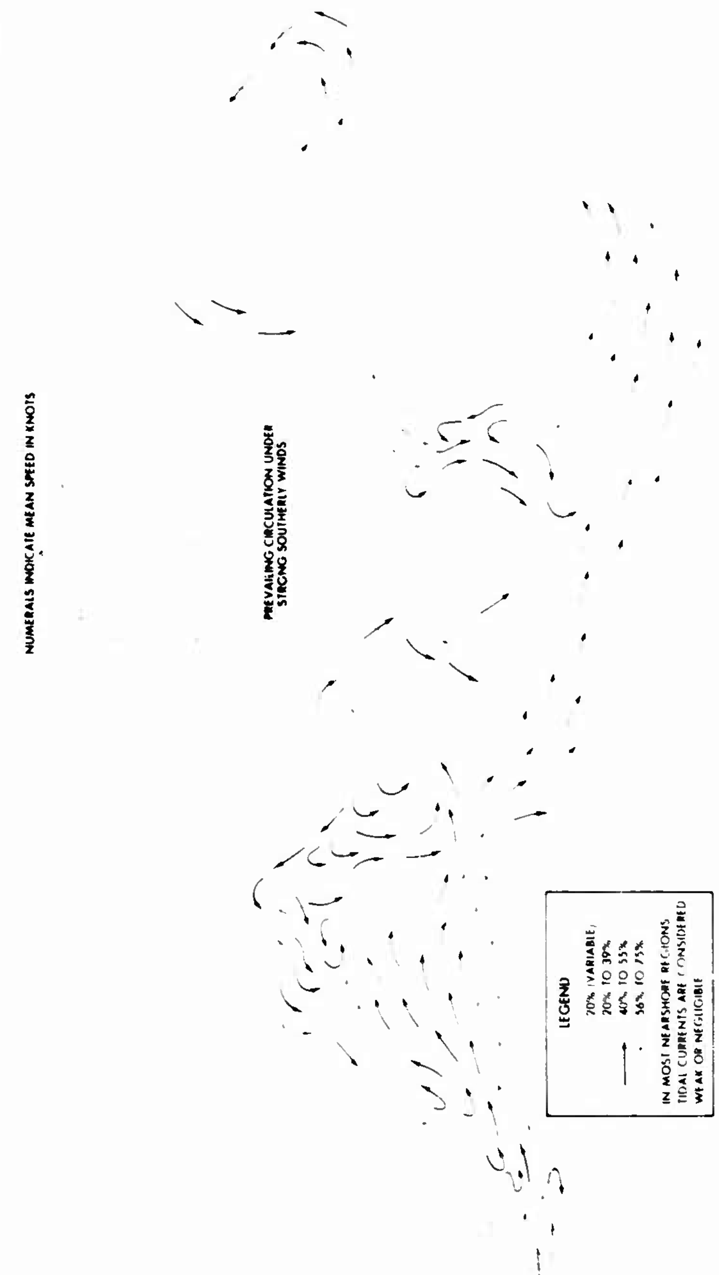


FIG. 12 PREVAILING SURFACE CURRENTS WITH MEAN SPEEDS (KNOTS), MEDITERRANEAN SEA (JANUARY THROUGH DECEMBER)

FIG. 13 SURFACE TIDAL CURRENTS AT SPRINGS, OF GIBRALTAR

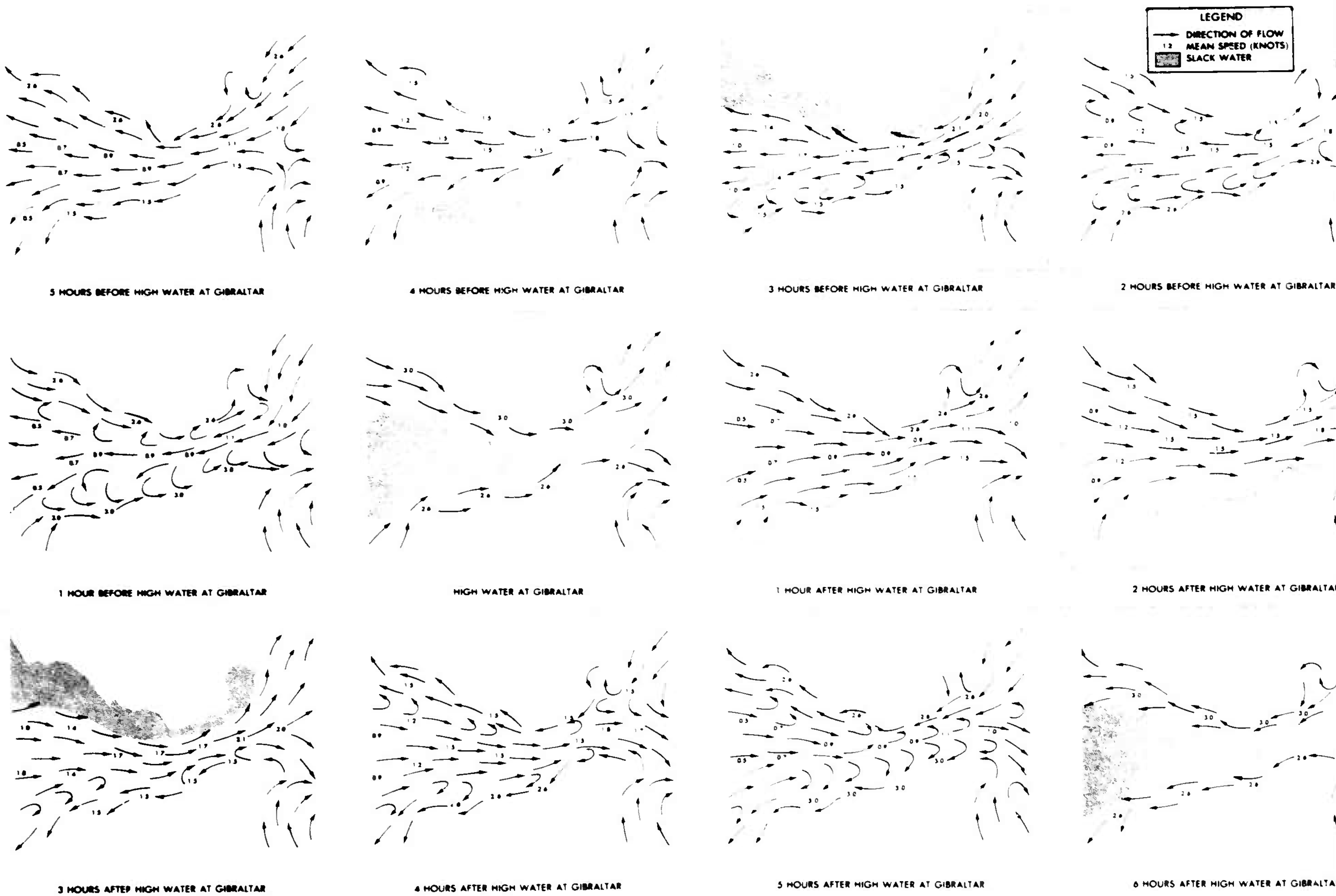


FIG. 14 TYPES OF TIDES, COTIDAL LINES AND LOCATIONS OF TYPICAL TIDE CURVES

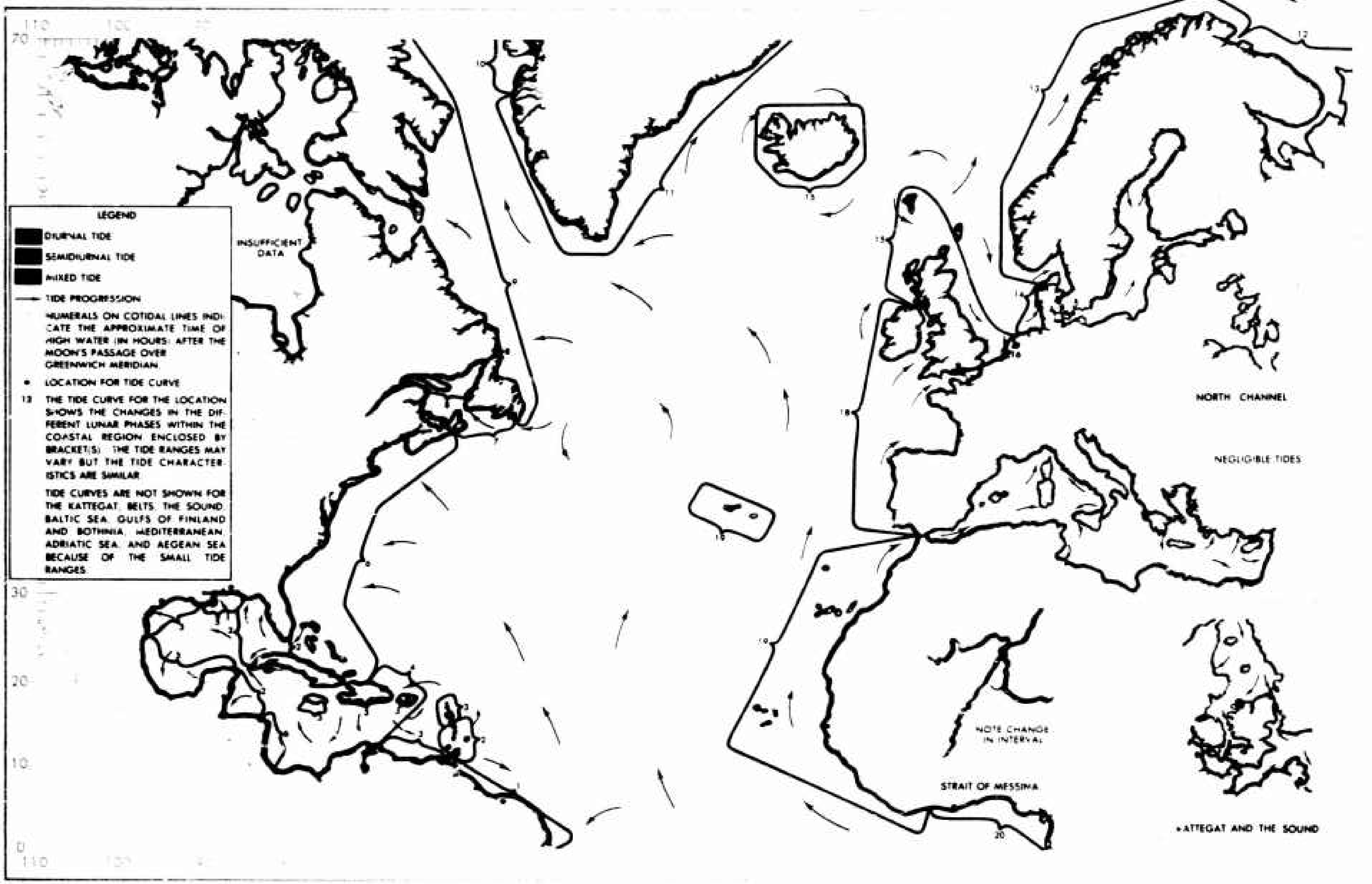


FIG. 15 TYPICAL TIDE CURVES

TYPICAL TIDE CURVES
SEE FIG. 14 FOR LOCATION OF TIDE CURVES

MSL (MEAN SEA LEVEL) — THE AVERAGE HEIGHT ABOVE DATUM FOR ALL STAGES OF THE TIDE

MLW (MEAN LOW WATER) — THE AVERAGE HEIGHT OF THE LOW WATERS

MHW (MEAN HIGH WATER) — THE AVERAGE HEIGHT OF THE HIGH WATERS

MTL (MEAN TIDE LEVEL) — THE AVERAGE HEIGHT OF THE HIGH WATERS AND LOW WATERS

MLLW (MEAN LOWER LOW WATER) — THE AVERAGE HEIGHT OF THE LOWER LOW WATERS

MLWN (MEAN LOW WATER NEAPS) — THE AVERAGE HEIGHT OF LOW WATERS OCCURRING NEAR THE TIME OF FIRST OR LAST QUARTER NEAP TIDES

MHWN (MEAN HIGH WATER NEAPS) — THE AVERAGE HEIGHT OF HIGH WATERS OCCURRING NEAR THE TIME OF FIRST OR LAST QUARTER NEAP TIDES

MLHW (MEAN LOWER HIGH WATER) — THE AVERAGE HEIGHT OF THE LOWER HIGH WATERS

MHLW (MEAN HIGHER LOW WATER) — THE AVERAGE HEIGHT OF THE HIGHER LOW WATERS

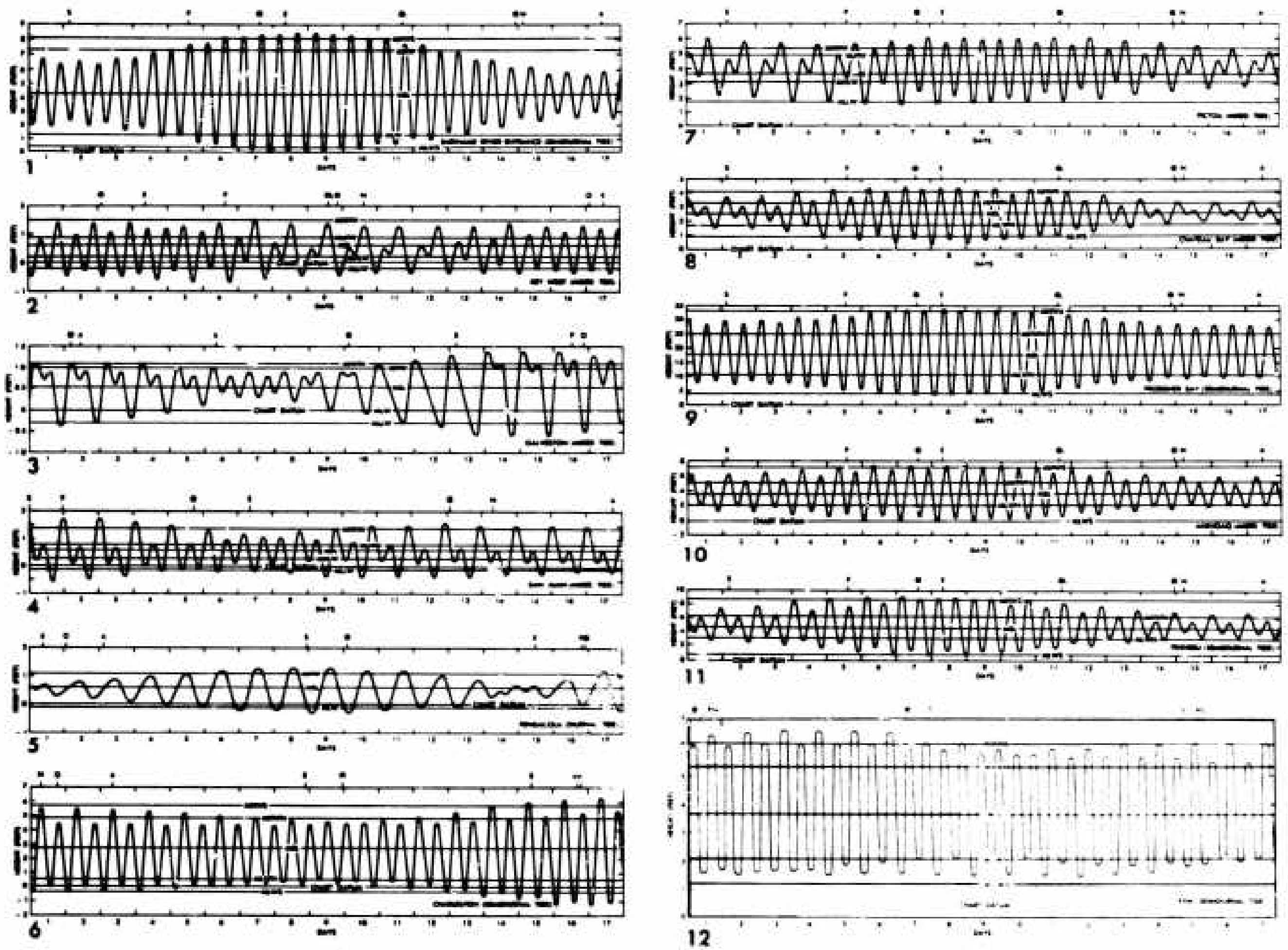
MHHW (MEAN HIGHER HIGH WATER) — THE AVERAGE HEIGHT OF THE HIGHER HIGH WATERS

MLWS (MEAN LOW WATER SPRINGS) — THE AVERAGE HEIGHT OF LOW WATERS OCCURRING NEAR THE TIME OF NEW OR FULL MOON SPRING TIDES

MHWS (MEAN HIGH WATER SPRINGS) — THE AVERAGE HEIGHT OF HIGH WATERS OCCURRING NEAR THE TIME OF NEW OR FULL MOON SPRING TIDES

CHART DATUM — THE REFERENCE LEVEL FROM WHICH THE PREDICTED TIDE HEIGHTS ARE MEASURED

● NEW MOON
○ FULL MOON
◐ LAST QUARTER
◑ FIRST QUARTER
A MOON IN APOGEE
E MOON ON EQUATOR
N MOON FARTHEST NORTH OF EQUATOR
S MOON FARTHEST SOUTH OF EQUATOR
P MOON IN PERIGEE
⊕ SUN AT VERNAL EQUINOX



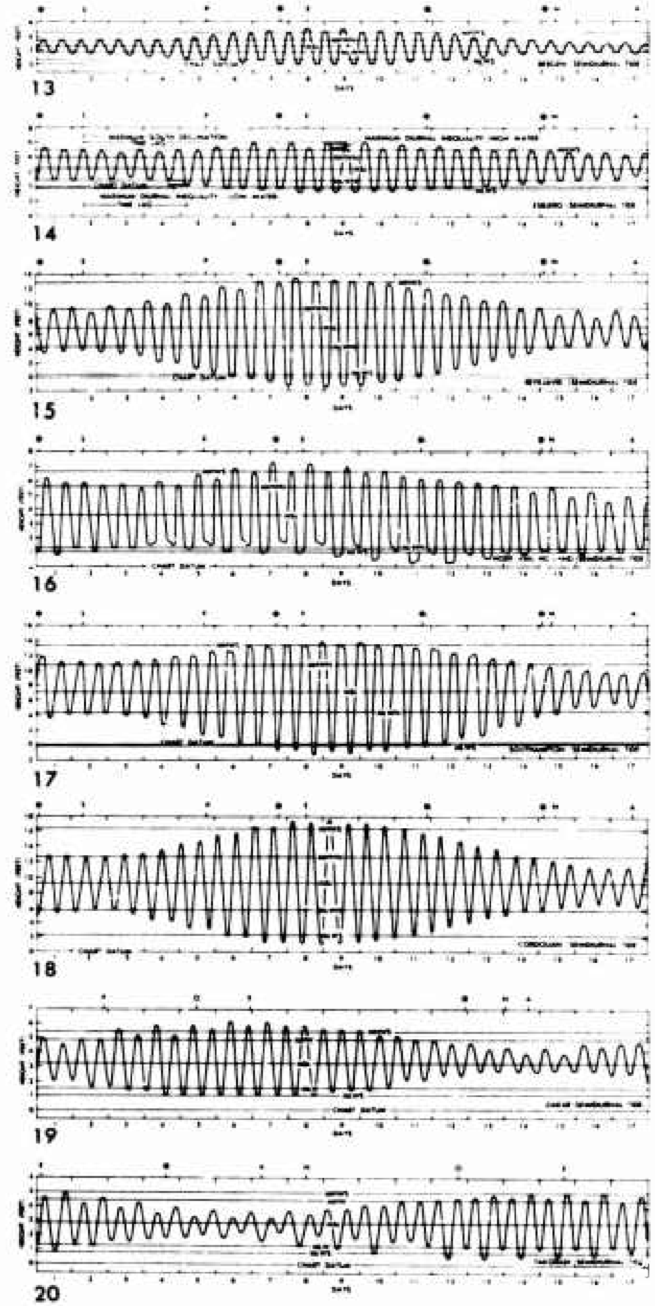


FIG. 16 TIDE RANGES

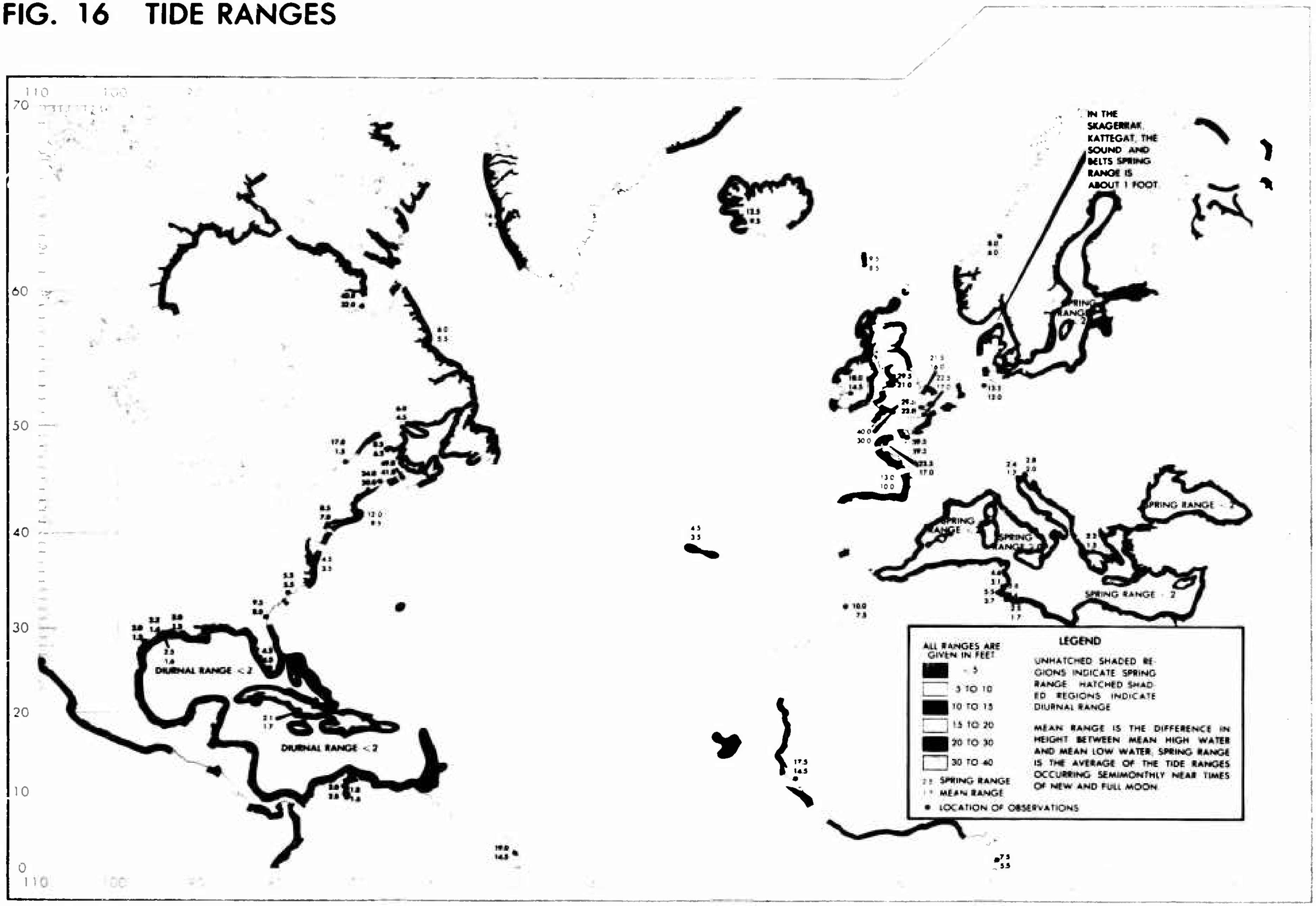
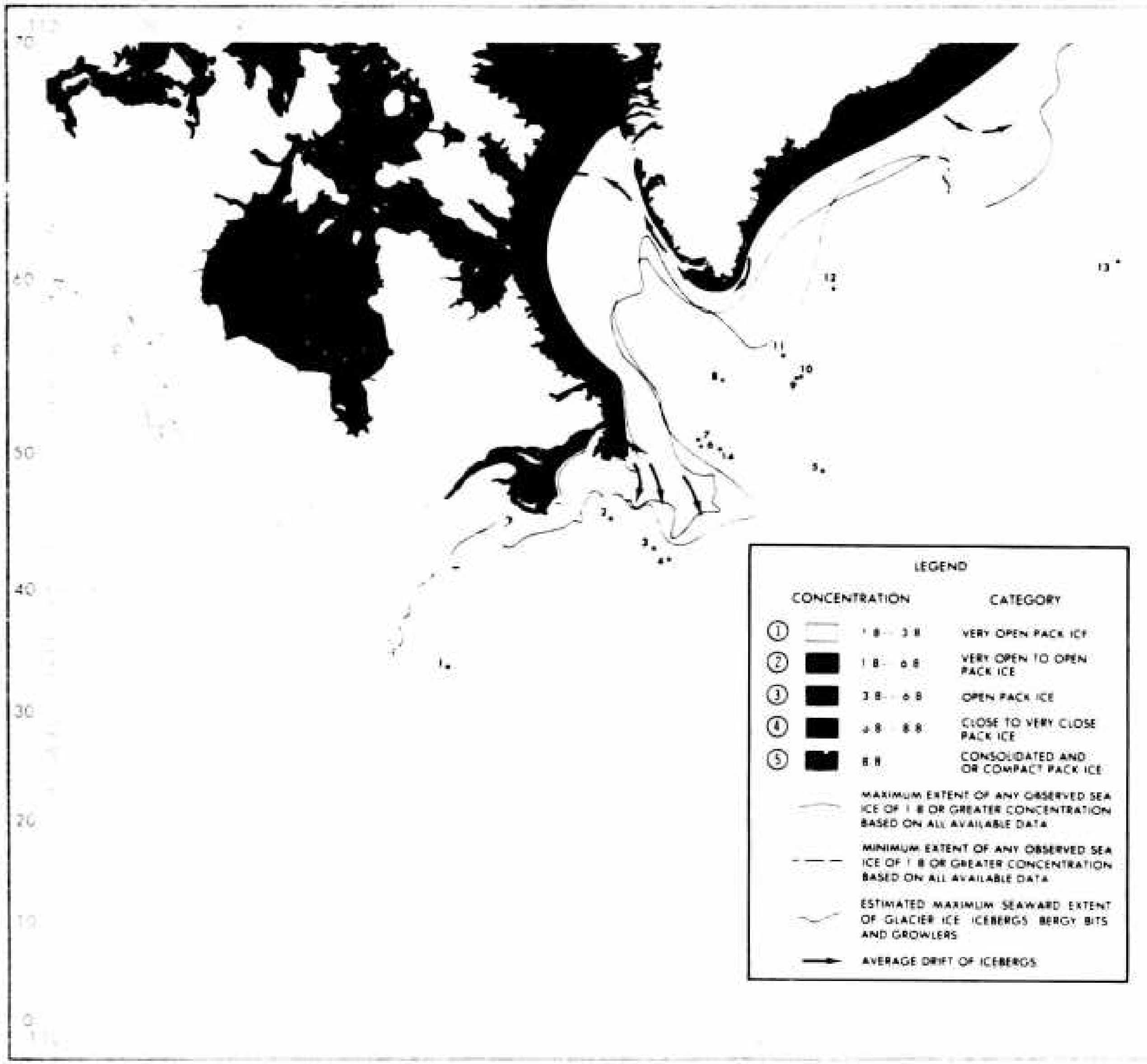


FIG. 17 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, JANUARY



EXCEPTIONAL OBSERVATIONS OF ICE

JANUARY

1 HUMMOCKED PIECE OF ICE 30 FEET IN DIAMETER 2 FEET HIGH WAS SIGHTED AT 33 30 N 71 00 W IN 1916
2 ICEBERG WAS OBSERVED NEAR 45 10 N 55 20 W IN 1920
3 ICEBERG WAS OBSERVED NEAR 43 00 N 51 10 W IN 1920
4 ICEBERG OR PIECE OF ICE WAS OBSERVED AT 41°57 N 49°26 W IN 1921
5 ICEBERG 400 FEET LONG 40 FEET HIGH WAS SIGHTED AT 48°37 N 54 42 W IN 1913
6 ICEBERG WAS OBSERVED AT 50 30 N 46 30 W IN 1913
7 ICEBERG WAS OBSERVED AT 50°45 N 46 45 W IN 1929
8 SMALL ICEBERG WAS OBSERVED AT 54°21 N 44°24 W IN 1944
9 ICEBERG WAS OBSERVED AT 54 35 N 37 03 W IN 1950
10 ICEBERG WAS OBSERVED AT 54°37 N 36°57 W IN 1950
11 ICEBERG WAS OBSERVED AT 55 50 N 38°28 W IN 1950
12 ICEBERG WAS OBSERVED AT 59°30 N 33 23 W IN 1954
13 TWO ICEBERGS WERE SIGHTED AT 60°55 N 5 50 W IN 1836
14 ICEBERG WAS OBSERVED AT 50 11 N 44 37 W IN 1969

FIG. 18 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, FEBRUARY

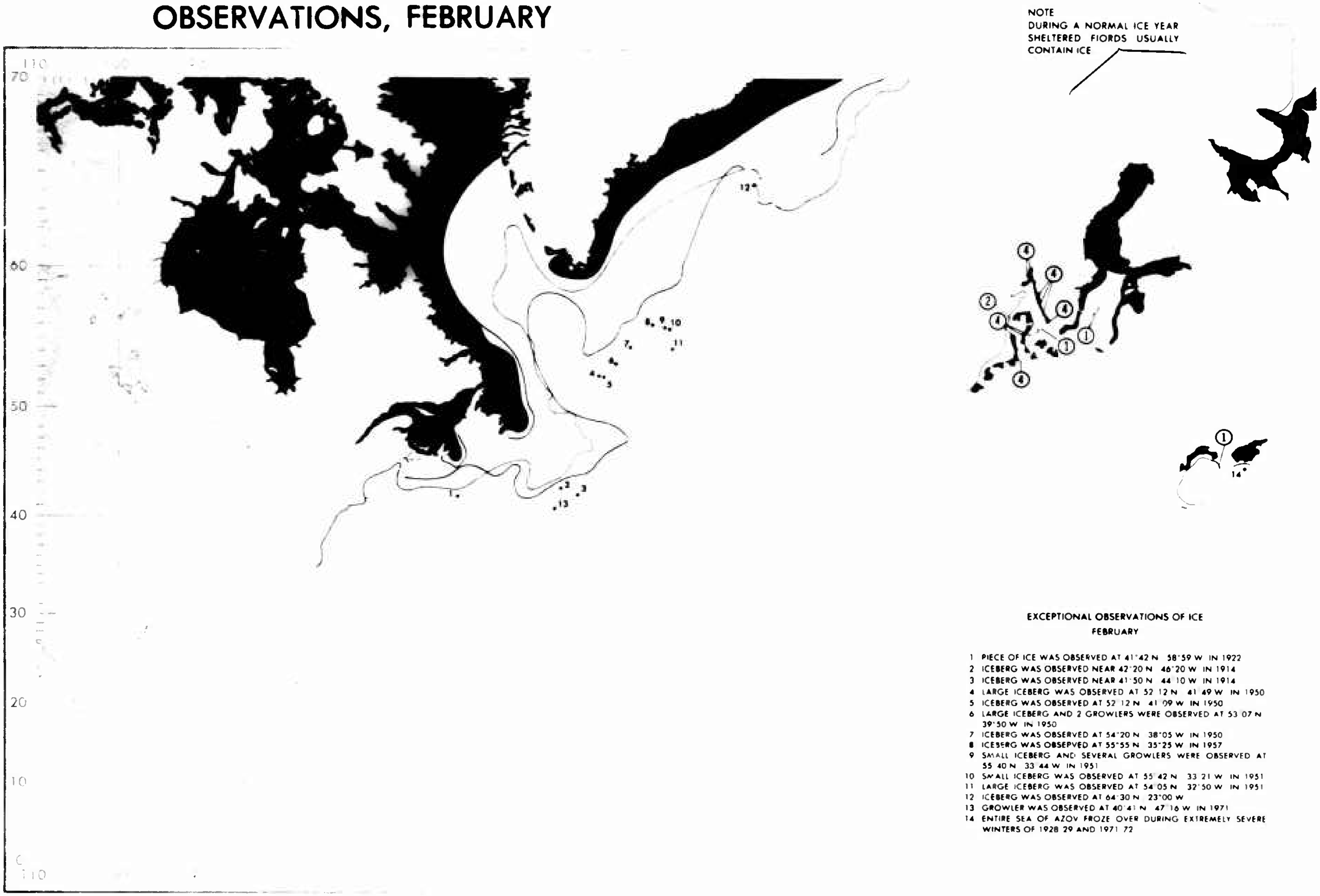


FIG. 19 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, MARCH

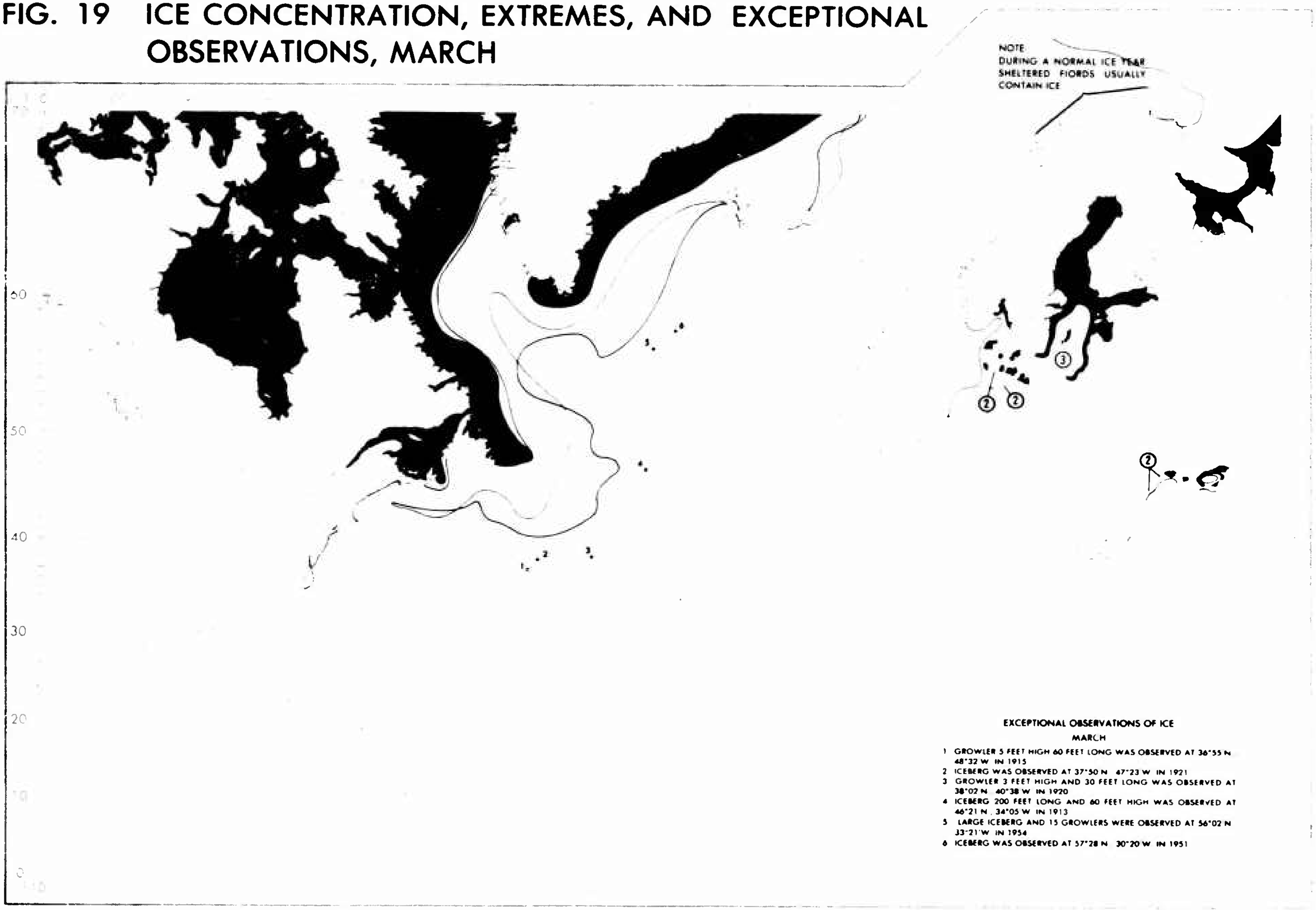
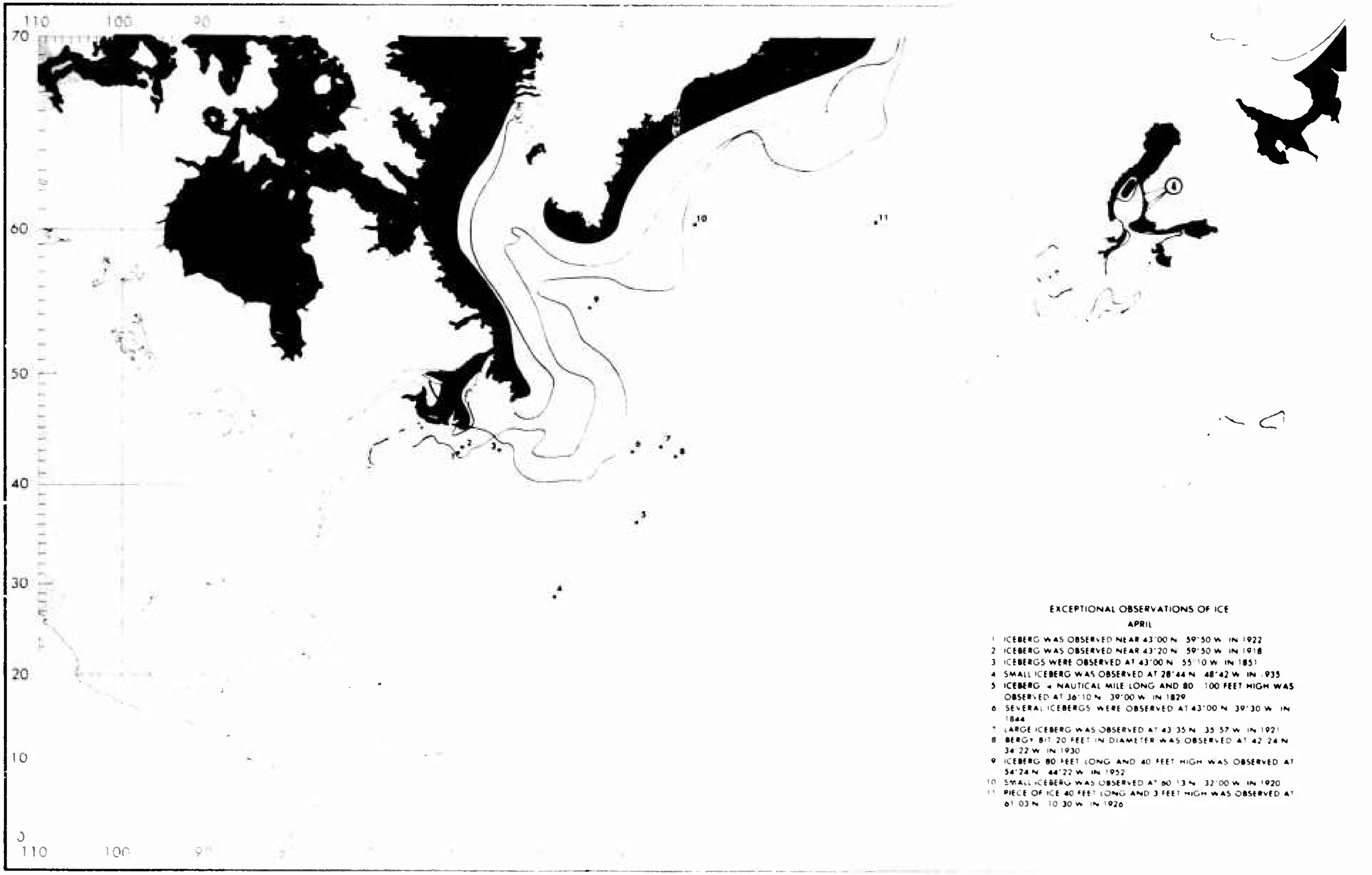


FIG. 20 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, APRIL

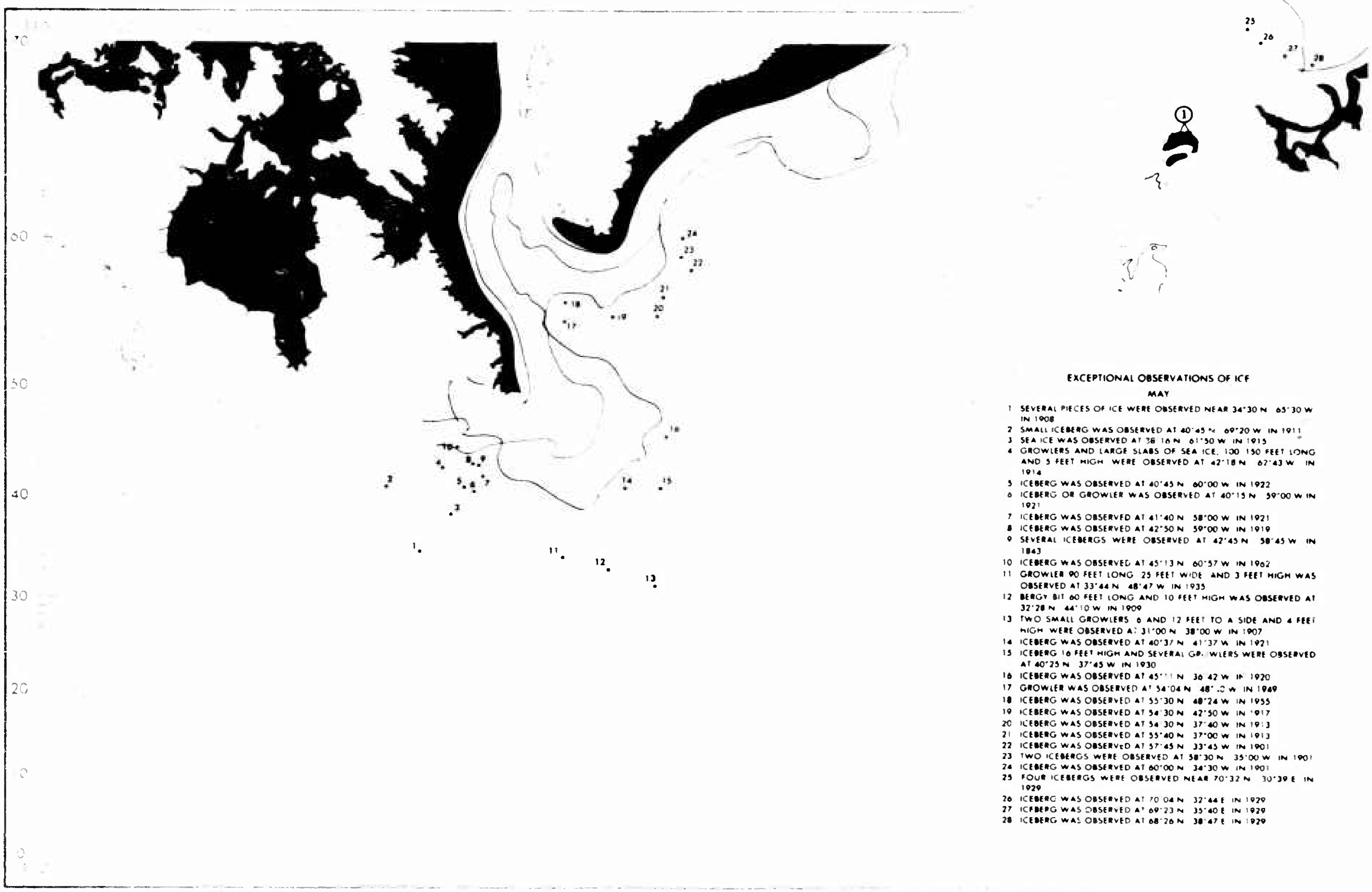


EXCEPTIONAL OBSERVATIONS OF ICE

APRIL

1 ICEBERG WAS OBSERVED NEAR 43°00 N 59°50 W IN 1922
2 ICEBERG WAS OBSERVED NEAR 43°20 N 59°50 W IN 1918
3 ICEBERGS WERE OBSERVED AT 43°00 N 55°10 W IN 1851
4 SMALL ICEBERG WAS OBSERVED AT 28°44 N 48°42 W IN 1935
5 ICEBERG ¼ NAUTICAL MILE LONG AND 80 100 FEET HIGH WAS OBSERVED AT 36°10 N 39°00 W IN 1829
6 SEVERAL ICEBERGS WERE OBSERVED AT 43°00 N 39°30 W IN 1844
7 LARGE ICEBERG WAS OBSERVED AT 43°35 N 35°57 W IN 1921
8 BERGY BIT 20 FEET IN DIAMETER WAS OBSERVED AT 42°24 N 34°22 W IN 1930
9 ICEBERG 80 FEET LONG AND 40 FEET HIGH WAS OBSERVED AT 54°24 N 44°22 W IN 1952
10 SMALL ICEBERG WAS OBSERVED AT 60°13 N 32°00 W IN 1920
11 PIECE OF ICE 40 FEET LONG AND 3 FEET HIGH WAS OBSERVED AT 61°03 N 10°30 W IN 1926

FIG. 21 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, MAY



EXCEPTIONAL OBSERVATIONS OF ICE
MAY

1 SEVERAL PIECES OF ICE WERE OBSERVED NEAR 34°30 N 65°30 W IN 1908
2 SMALL ICEBERG WAS OBSERVED AT 40°45 N 69°20 W IN 1911
3 SEA ICE WAS OBSERVED AT 38°16 N 61°50 W IN 1915
4 GROWLERS AND LARGE SLABS OF SEA ICE, 100 150 FEET LONG AND 5 FEET HIGH WERE OBSERVED AT 42°18 N 67°43 W IN 1914
5 ICEBERG WAS OBSERVED AT 40°45 N 60°00 W IN 1922
6 ICEBERG OR GROWLER WAS OBSERVED AT 40°15 N 59°00 W IN 1921
7 ICEBERG WAS OBSERVED AT 41°40 N 58°00 W IN 1921
8 ICEBERG WAS OBSERVED AT 42°50 N 59°00 W IN 1919
9 SEVERAL ICEBERGS WERE OBSERVED AT 42°45 N 58°45 W IN 1843
10 ICEBERG WAS OBSERVED AT 45°13 N 60°57 W IN 1962
11 GROWLER 90 FEET LONG 25 FEET WIDE AND 3 FEET HIGH WAS OBSERVED AT 33°44 N 48°47 W IN 1935
12 BERGY BIT 60 FEET LONG AND 10 FEET HIGH WAS OBSERVED AT 32°28 N 44°10 W IN 1909
13 TWO SMALL GROWLERS 6 AND 12 FEET TO A SIDE AND 4 FEET HIGH WERE OBSERVED AT 31°00 N 38°00 W IN 1907
14 ICEBERG WAS OBSERVED AT 40°37 N 41°37 W IN 1921
15 ICEBERG 16 FEET HIGH AND SEVERAL GROWLERS WERE OBSERVED AT 40°25 N 37°45 W IN 1930
16 ICEBERG WAS OBSERVED AT 45°[illegible] N 36°42 W IN 1920
17 GROWLER WAS OBSERVED AT 54°04 N 48°[illegible] W IN 1949
18 ICEBERG WAS OBSERVED AT 55°30 N 48°24 W IN 1955
19 ICEBERG WAS OBSERVED AT 54°30 N 42°50 W IN 1917
20 ICEBERG WAS OBSERVED AT 54°30 N 37°40 W IN 1913
21 ICEBERG WAS OBSERVED AT 55°40 N 37°00 W IN 1913
22 ICEBERG WAS OBSERVED AT 57°45 N 33°45 W IN 1901
23 TWO ICEBERGS WERE OBSERVED AT 58°30 N 35°00 W IN 1901
24 ICEBERG WAS OBSERVED AT 60°00 N 34°30 W IN 1901
25 FOUR ICEBERGS WERE OBSERVED NEAR 70°32 N 30°39 E IN 1929
26 ICEBERG WAS OBSERVED AT 70°04 N 32°44 E IN 1929
27 ICEBERG WAS OBSERVED AT 69°23 N 35°40 E IN 1929
28 ICEBERG WAS OBSERVED AT 68°26 N 38°47 E IN 1929

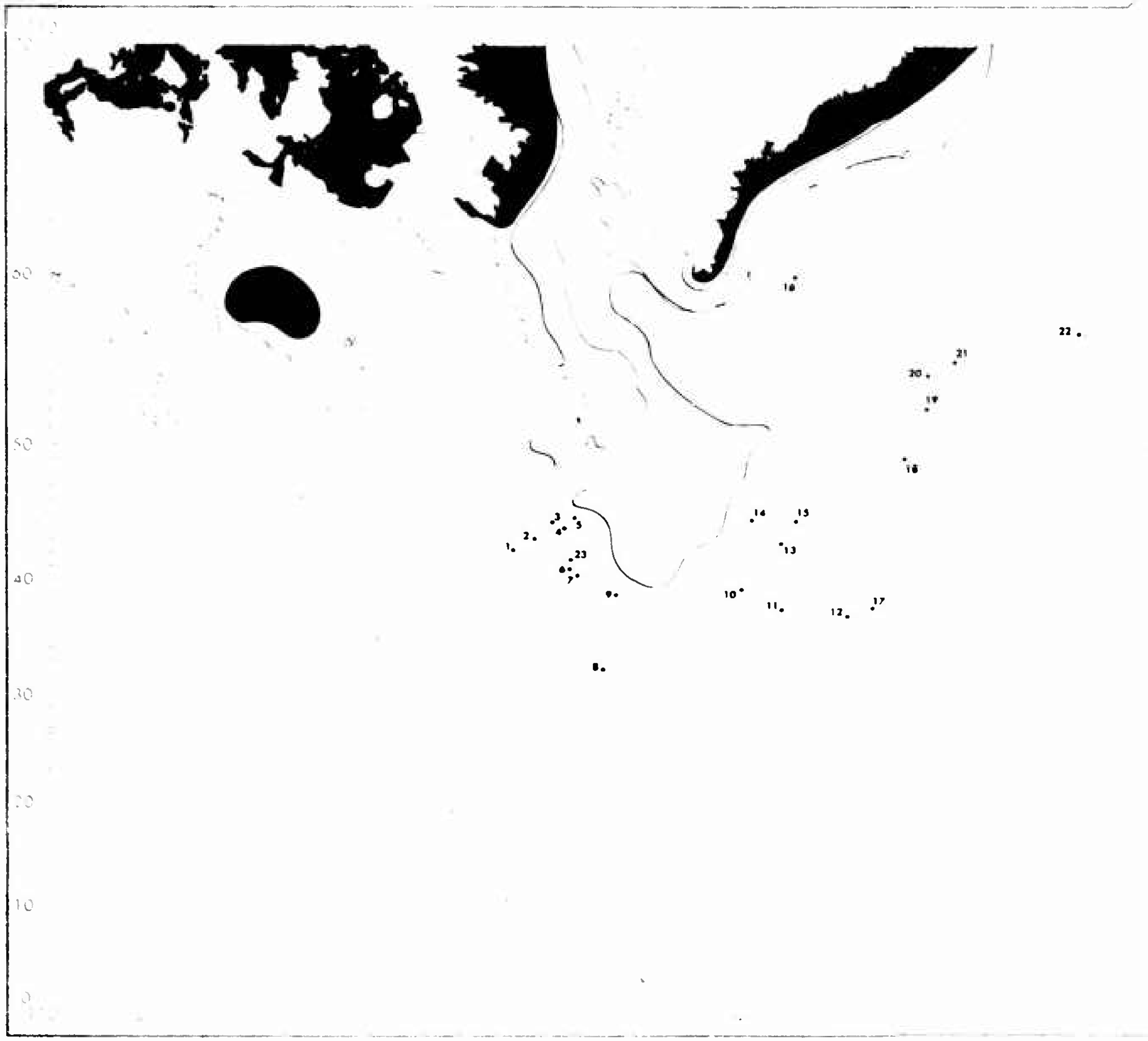
FIG. 22 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, JUNE

EXCEPTIONAL OBSERVATIONS OF ICE

JUNE

1 SEVERAL ICEBERGS WERE AT 32 37 N 64 25 W IN 1907
2 THREE PIECES OF ICE WERE OBSERVED AT 37°30 N 74 24 W IN 1912
3 GROWLER WAS OBSERVED AT 38°03 N 63 20 W IN 1924
4 ICEBERG 10 FEET HIGH WAS OBSERVED AT 39°35 N 64 50 W IN 1913
5 ICEBERG WAS OBSERVED AT 42°35 N 59°05 W IN 1921
6 SMALL PIECE OF ICE WAS OBSERVED AT 36 28 N 57°45 W IN 1915
7 BERGY BIT 10 FEET WAS OBSERVED AT 33 20 N 49 16 W IN 1921
8 GROWLER 30 FEET LONG 15 FEET WIDE AND 3 FEET HIGH WAS OBSERVED AT 30°50 N 45°06 W IN 1934
9 ICEBERG WAS OBSERVED AT 38 30 N 45 50 W IN 1912
10 ICEBERG WAS OBSERVED AT 59°46 N 38°21 W IN 1914
11 ICEBERG WAS OBSERVED AT 51 27 N 12 25 W IN 1907
12 LARGE ICEBERG WAS OBSERVED AT 48 40 N 15 27 W IN 1886
13 ICEBERG WAS OBSERVED NEAR 62 55 N 24 20 W IN 1960

FIG. 23 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, JULY

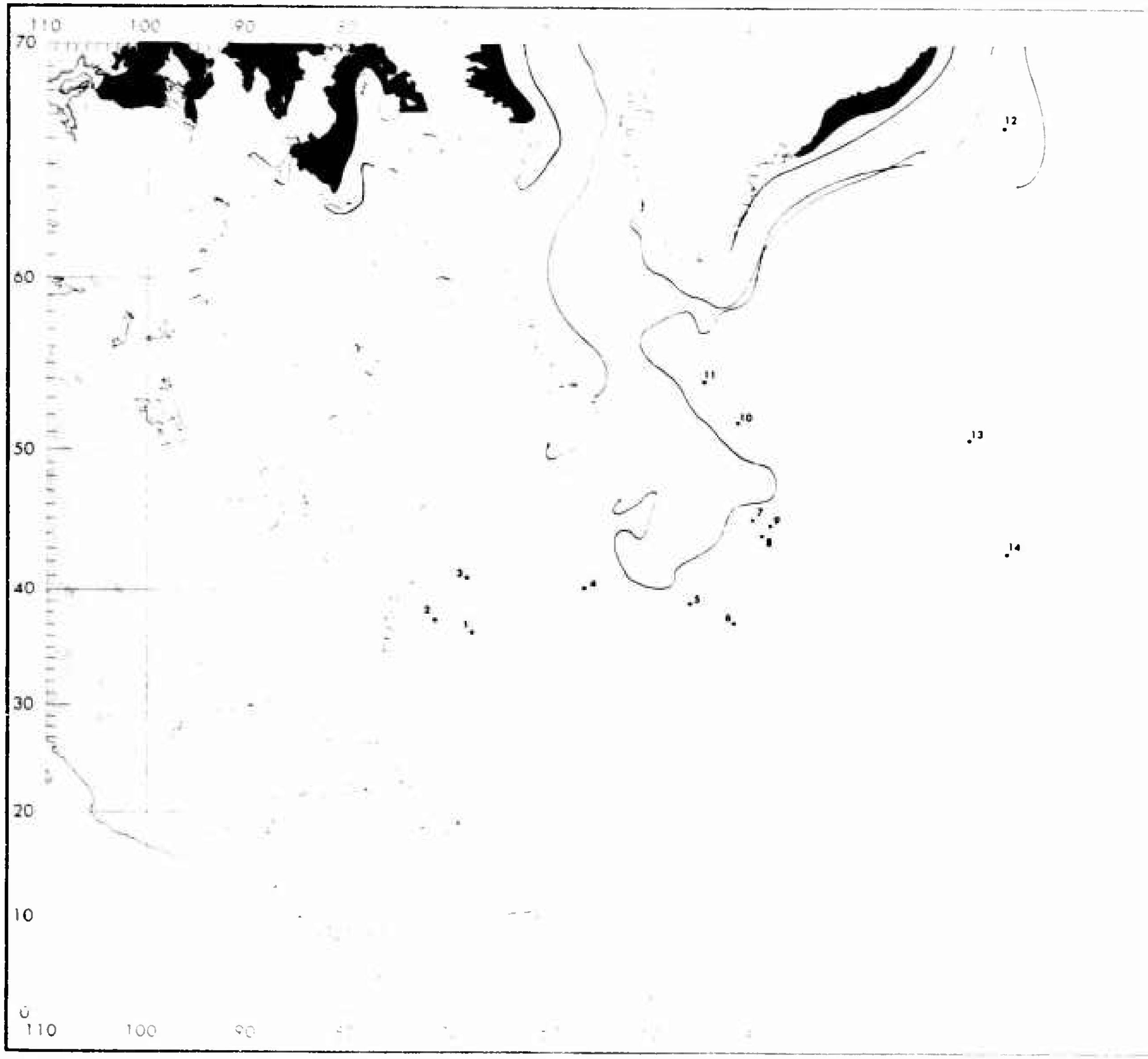


EXCEPTIONAL OBSERVATIONS OF ICE

JULY

1 ICEBERG 60 FEET LONG WAS OBSERVED AT 42°09 N 6 24 W IN 1916
2 GROWLERS 2 FEET HIGH WERE OBSERVED AT 43°05 N 61°15 W IN 1836
3 ICEBERG WAS OBSERVED NEAR 44°20 N 59°30 W IN 1913
4 HUGE ICEBERG WAS OBSERVED AT 43°55 N 58°05 W IN 1844
5 ICEBERG WAS OBSERVED AT 44°35 N 57°15 W IN 192?
6 ICEBERG WAS OBSERVED AT 40°50 N 57°40 W IN 1916
7 ICEBERG WAS OBSERVED AT 40°20 N 57°00 W IN 1911
8 GROWLER 3 TO 4 FEET HIGH WAS OBSERVED AT 32°09 N 54°26 W IN 1916
9 ICEBERG WAS OBSERVED AT 38°40 N 53°10 W IN 1912
10 ICEBERG WAS OBSERVED AT 39°09 N 40°39 W IN 1921
11 BERGY BIT 50 FEET ACROSS AND 6 FEET HIGH WAS OBSERVED AT 37°27 N 36°48 W IN 1913
12 GROWLER 25 FEET LONG 3 FEET WIDE AND 8 FEET HIGH WAS OBSERVED AT 36°59 N 30°01 W IN 1909
13 TWO PIECES OF ICE WERE OBSERVED AT 42°42 N 36°45 W IN 1926
14 BERGY BIT ABOUT 15 FEET ON A SIDE WAS OBSERVED AT 44°30 N 39°26 W IN 1921
15 LARGE ICEBERG WAS OBSERVED AT 44°25 N 35°01 W IN 1918
16 ICEBERG WAS OBSERVED AT 59°38 N 35°02 W IN 1922
17 ICEBERG WAS OBSERVED AT 37°37 N 27°29 W IN 1921
18 REMNANT OF ICEBERG WAS OBSERVED AT 48°53 N 24°11 W IN 1890
19 CHUNK OF ICE ABOUT 25 BY 12 FEET WAS OBSERVED AT 52°32 N 22°00 W IN 1933
20 ICEBERG WAS OBSERVED AT 54°00 N 22°00 W IN 1958
21 POSSIBLE ICEBERG WAS OBSERVED AT 54°47 N 19°22 W IN 1958
22 PIECE OF ICE 40 TO 50 FEET LONG 15 FEET WIDE AND 2½ FEET HIGH WAS OBSERVED AT 56°30 N 6°30 W IN 1902
23 ICEBERG WAS OBSERVED AT 41°27 N 57°30 W IN 1972
24 ICEBERG WAS OBSERVED AT 67°44 N 40°55 E IN 1929

FIG. 24 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, AUGUST



EXCEPTIONAL OBSERVATIONS OF ICE

AUGUST

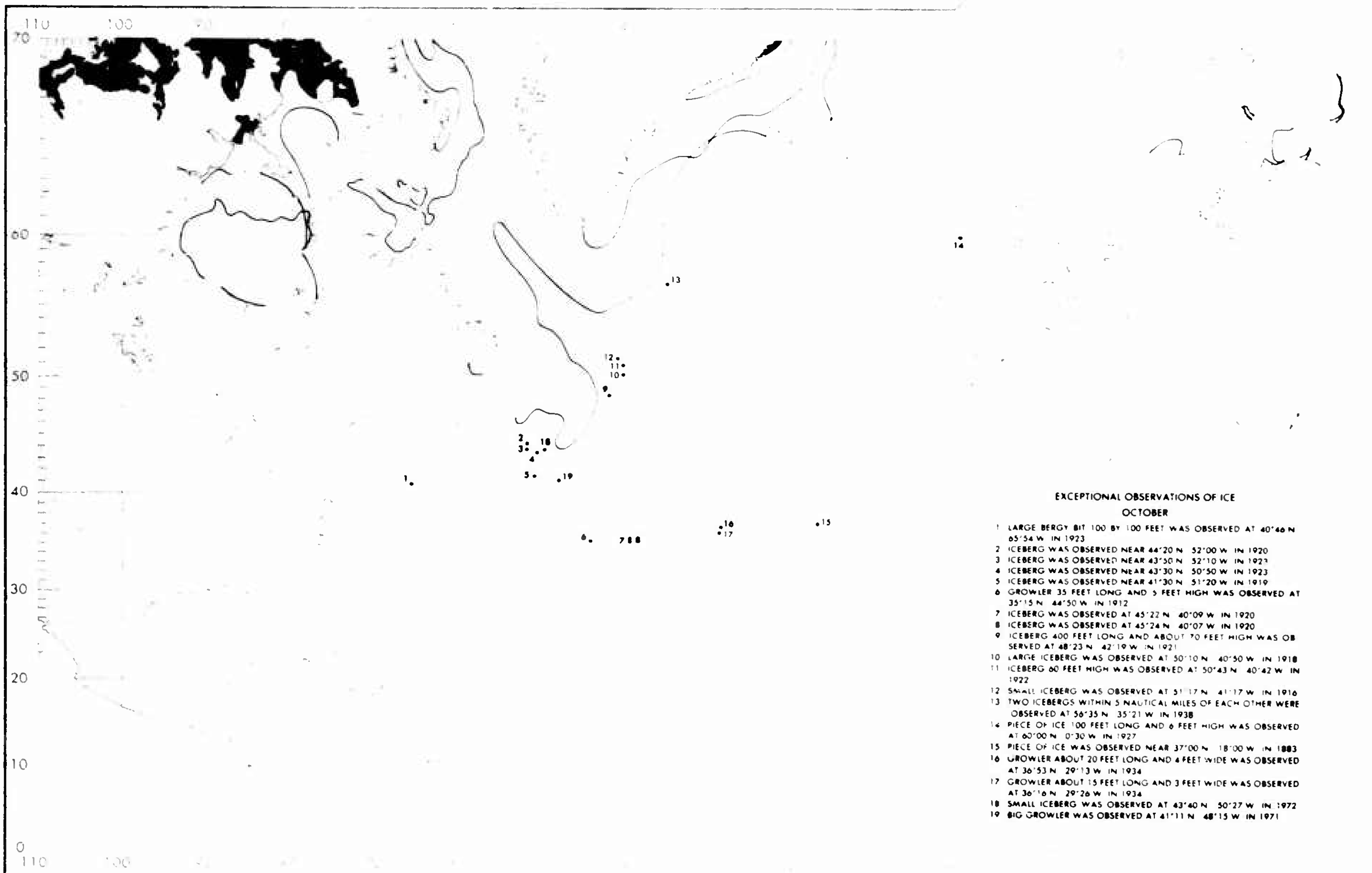
1 SEVERAL BERGY BITS WERE OBSERVED AT 36°20 N 67°47 W IN 1831
2 PIECE OF ICE 40 FEET LONG AND 3 FEET HIGH WAS OBSERVED AT 37°30 N 71°30 W IN 1903
3 GROWLER WAS OBSERVED AT 40°46 N 68°20 W IN 1915
4 ICEBERG WAS OBSERVED AT 41°09 N 56°43 W IN 1915
5 GROWLER 20 FEET ACROSS AND 4 FEET HIGH WAS OBSERVED AT 39°00 N 46°20 W IN 1915
6 GROWLER 18 FEET LONG 5 FEET WIDE AND 2 FEET HIGH WAS OBSERVED AT 37°16 N 42°06 W IN 1909
7 ICEBERG WAS OBSERVED NEAR 44°50 N 40°00 W IN 1921
8 PIECE OF ICE WAS OBSERVED NEAR 43°55 N 39°16 W IN 1912
9 ICEBERG 100 FEET HIGH WAS OBSERVED NEAR 44°30 N 38°30 W IN 1833
10 ICEBERG WAS OBSERVED AT 51°30 N 41°30 W IN 1922
11 ICEBERG WAS OBSERVED AT 53°50 N 44°50 W IN 1913
12 ICEBERG WAS OBSERVED AT 60°30 N 15°40 W IN 1936
13 TWO SQUARE CHUNKS OF ICE 10 FEET AND 15 FEET TO A SIDE WERE OBSERVED AT 50°31 N 18°55 W IN 1908
14 GROWLER 50 FEET LONG AND 4 FEET HIGH WAS OBSERVED AT 42°30 N 15°26 W IN 1912

FIG. 25 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, SEPTEMBER

EXCEPTIONAL OBSERVATIONS OF ICE
SEPTEMBER

1 TWO ICEBERGS 300-400 FEET LONG AND 30 FEET HIGH ACCOMPANIED BY AN ICE FIELD ABOUT 2 NAUTICAL SQUARE MILES IN AREA WERE OBSERVED AT 36°35 N 71°36 W IN 1895
2 ICEBERG WAS OBSERVED AT 44°10 N 60°50 W IN 1919
3 ICEBERG WAS OBSERVED NEAR 38°30 N 46°30 W IN 1919
4 ICEBERG WAS OBSERVED NEAR 35°20 N 44°00 W IN 1912
5 PIECE OF ICE WAS OBSERVED AT 35°40 N 30°00 W IN 1883
6 ICEBERG WAS OBSERVED AT 47°10 N 38°04 W IN 1920
7 ICEBERG WAS OBSERVED AT 50°00 N 40°05 W IN 1922
8 LARGE ICEBERG WAS OBSERVED AT 52°52 N 40°12 W IN 1922
9 ICEBERG WAS OBSERVED AT 53°00 N 46°30 W IN 1913
10 ICEBERG WAS OBSERVED AT 53°10 N 46°30 W IN 1911
11 ICEBERG WAS OBSERVED AT 53°30 N 47°50 W IN 1913
12 ICEBERG WAS OBSERVED AT 53°50 N 47°50 W IN 1911
13 ICEBERG WAS OBSERVED AT 55°50 N 50°20 W IN 1912
14 TWO LARGE ICEBERGS AND A GROWLER WERE OBSERVED AT 56°39 N 41°18 W IN 1938
15 UNUSUALLY LARGE ICEBERG WAS OBSERVED AT 64°30 N 29°30 W IN 1912
16 BERGY BIT 20 FEET LONG AND 6 FEET WIDE WAS OBSERVED AT 54°20 N 22°00 W IN 1906
17 ONE LARGE AND TWO SMALL ICEBERGS WERE OBSERVED AT 45°28 N 27°18 W IN 1908
18 POSSIBLE GROWLER WAS OBSERVED AT 39°40 N 28°15 W IN 1948
19 GROWLER 20-30 FEET LONG AND 4 FEET HIGH AND SEVERAL PIECES OF ICE WERE OBSERVED NEAR 38°50 N 28°40 W IN 1948
20 GROWLER 30 FEET LONG AND 2 FEET HIGH, AND PIECE OF ICE WERE OBSERVED AT 38°11 N 27°39 W IN 1948

FIG. 26 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, OCTOBER



EXCEPTIONAL OBSERVATIONS OF ICE

OCTOBER

1 LARGE BERGY BIT 100 BY 100 FEET WAS OBSERVED AT 40°46 N 65°54 W IN 1923
2 ICEBERG WAS OBSERVED NEAR 44°20 N 52°00 W IN 1920
3 ICEBERG WAS OBSERVED NEAR 43°50 N 52°10 W IN 1923
4 ICEBERG WAS OBSERVED NEAR 43°30 N 50°50 W IN 1923
5 ICEBERG WAS OBSERVED NEAR 41°30 N 51°20 W IN 1919
6 GROWLER 35 FEET LONG AND 5 FEET HIGH WAS OBSERVED AT 35°15 N 44°50 W IN 1912
7 ICEBERG WAS OBSERVED AT 45°22 N 40°09 W IN 1920
8 ICEBERG WAS OBSERVED AT 45°24 N 40°07 W IN 1920
9 ICEBERG 400 FEET LONG AND ABOUT 70 FEET HIGH WAS OBSERVED AT 48°23 N 42°19 W IN 1921
10 LARGE ICEBERG WAS OBSERVED AT 50°10 N 40°50 W IN 1918
11 ICEBERG 60 FEET HIGH WAS OBSERVED AT 50°43 N 40°42 W IN 1922
12 SMALL ICEBERG WAS OBSERVED AT 51°17 N 41°17 W IN 1916
13 TWO ICEBERGS WITHIN 5 NAUTICAL MILES OF EACH OTHER WERE OBSERVED AT 56°35 N 35°21 W IN 1938
14 PIECE OF ICE 100 FEET LONG AND 6 FEET HIGH WAS OBSERVED AT 60°00 N 0°30 W IN 1927
15 PIECE OF ICE WAS OBSERVED NEAR 37°00 N 18°00 W IN 1883
16 GROWLER ABOUT 20 FEET LONG AND 4 FEET WIDE WAS OBSERVED AT 36°53 N 29°13 W IN 1934
17 GROWLER ABOUT 15 FEET LONG AND 3 FEET WIDE WAS OBSERVED AT 36°16 N 29°26 W IN 1934
18 SMALL ICEBERG WAS OBSERVED AT 43°40 N 50°27 W IN 1972
19 BIG GROWLER WAS OBSERVED AT 41°11 N 48°15 W IN 1971

FIG. 27 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, NOVEMBER

EXCEPTIONAL OBSERVATIONS OF ICE
NOVEMBER

1 GROWLER ABOUT 60 FEET LONG AND 5 FEET HIGH WAS OBSERVED AT 32°44 N 49°58 W IN 1936
2 ICEBERG WAS OBSERVED NEAR 43°10 N 51°30 W IN 1915
3 ICEBERG WAS OBSERVED AT 42°45 N 51°05 W IN 1922
4 ICEBERG WAS OBSERVED NEAR 42°30 N 48°00 W IN 1919
5 ICEBERG WAS OBSERVED NEAR 43°20 N 46°00 W IN 1919
6 ICEBERG WAS OBSERVED NEAR 45°30 N 36°00 W IN 1918
7 ONE ICEBERG AND SEVERAL GROWLERS WERE OBSERVED AT 47°38 N 40°04 W IN 1922
8 ICEBERG WAS OBSERVED AT 50°50 N 40°50 W IN 1946
9 ICEBERG WAS OBSERVED AT 55°30 N 40°00 W IN 1918
10 ICEBERG WAS OBSERVED AT 57°09 N 36°33 W IN 1959
11 SEVERAL ICEBERGS WERE OBS'RVED AT 50°00 N 14°00 W IN 1842

FIG. 28 ICE CONCENTRATION, EXTREMES, AND EXCEPTIONAL OBSERVATIONS, DECEMBER

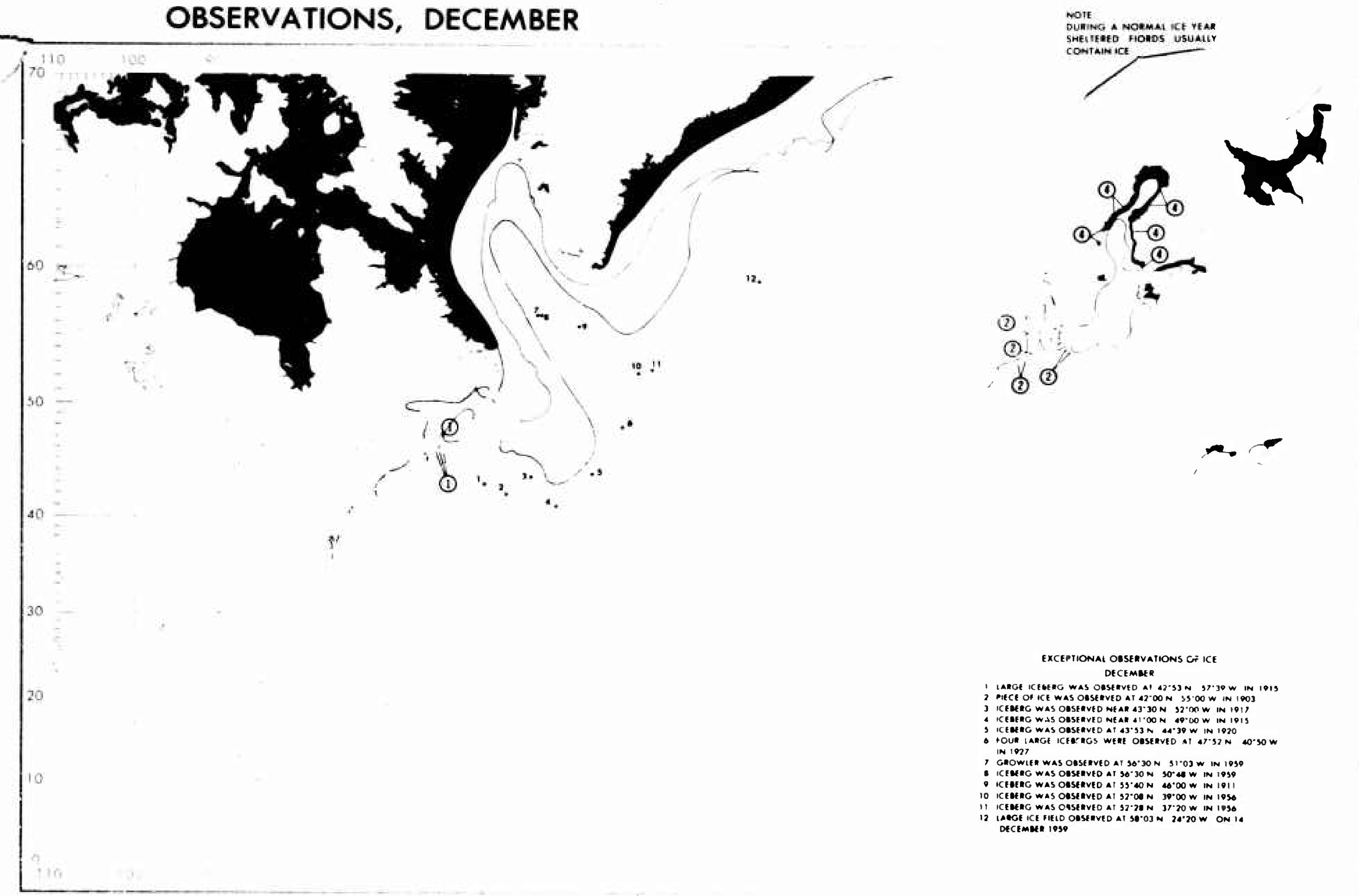


FIG. 29 FREEZEUP AND BREAKUP DATES

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS CANADA

NAME	LOCATION Latitude N	Longitude W	FIRST LOCAL ICE Earliest	Average	Latest	FIRST DRIFT ICE Average	FREEZEUP Average	END OF SHIPPING – Average	BREAKUP Average	START OF SHIPPING Average	LAST ICE Earliest	Average	Latest	MAXIMUM THICKNESS in 1 in = 2.54 cm Mean
Sydney	46°09	060°10	na	Early Jan	na	Early Mar	Early Jan	Early Jan	Early Apr	Early Apr	na	Early Apr	na	18.0 unk
Sept Iles	50°12	066°23	na	Late Dec	na	Late Dec	Late Dec	Late Dec	Early Apr	Mid Apr	na	Early Apr	na	25.0 unk
Saint John's	47°33	052°40	na	Jan	na	Early Feb	=	na	=	na	na	Late Apr	na	na
Strait of Belle Isle	51°30	056°30	na	Late Nov	na	Early Jan	na	28 Nov 51	Mid May	9 Jun 56	Apr	Mid Jun	na	na
Goose Bay	53°24	060°10	1 Nov 9	11 Nov 9	27 Nov 9	Dec	na	na	na	Late May	9 May 9	24 May 9	12 Jun 9	38.5 unk
Frobisher Bay	63°00	067°00	16 Oct 5	29 Oct 5	14 Nov 5	Early Nov	Mid Nov	Late Oct	Early Jun	Late Jul	na	22 Jul 5	na	60.0 5

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS GREENLAND

NAME	LOCATION Latitude N	Longitude W	FIRST LOCAL ICE Earliest	Average	Latest	FIRST DRIFT ICE Average	FREEZEUP Average	END OF SHIPPING – Average	BREAKUP Average	START OF SHIPPING Average	LAST ICE Earliest	Average	Latest	MAXIMUM THICKNESS in 1 in = 2.54 cm Mean
Godthaab	64°11	051°45	na	Oct	na	=	Dec	open	Mar	open	na	May	na	na
Frederikshaab	62°00	049°44	na	Dec	na	Late Apr	Jan	na	Mar	na	na	Jun	na	19.0 unk
Narssarssuak	61°11	045°25	na	Late Oct	na	Feb	Dec	na	Mar	na	na	Early Aug	na	25.8 unk

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS EAST GERMANY

NAME	LOCATION Latitude N	Longitude E	FIRST ICE Earliest	Average	Latest	LAST ICE Earliest	Average	Latest
Rostock	54°05	012°00	Mid Nov	Early Jan	*	*	Late Feb	Early Apr

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS WEST GERMANY

NAME	LOCATION Latitude N	Longitude E	FIRST ICE Earliest	Average	Latest	LAST ICE Earliest	Average	Latest
Lubeck	53°52	010°42	16 Dec 30	22 Jan 30	* 30	* 30	15 Feb 30	21 Mar 30
Flensburg	54°47	009°26	27 Nov 60	22 Jan 60	* 60	* 60	24 Feb 60	8 Apr 60
Wilhelmshaven	53°31	008°08	21 Nov 60	4 Jan 60	* 60	* 60	16 Feb 60	26 Mar 60
Emden	53°22	007°13	17 Nov 57	29 Dec 57	* 57	* 57	6 Feb 57	30 Mar 57

NOTES

– Shipping season may be extended by use of icebreakers or reinforced ships

na Data not available

unk Number of years unknown

= Occurrence of no freezeup during a season for years of record is greater than 50%

51 Number refers to years of definite data used in computing the date given. Exact dates, e.g. 28 Nov, are more accurate than indefinite dates, e.g. Early Jan. When dates are shown as indefinite the years of record were either indeterminable or of less than five years duration.

open Navigation not normally interrupted by ice

* In at least one year of record no ice occurred during a season

FIG. 29 FREEZEUP AND BREAKUP DATES (Cont'd)

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS NORWAY

NAME	LOCATION Latitude N	Longitude E	FIRST ICE Earliest	Average	Latest	END OF SHIPPING Earliest	Average	Latest	START OF SHIPPING Earliest	Average	Latest	LAST ICE Earliest	Average	Latest
Kristiansand fjorden	58°10	008°01	19 Jan 10	# 10	10	na	na	na	na	na	na	* 10	# 10	27 Mar 10
Langesundsfjord	59°00	009°40	29 Dec 11	# 10	* 11	11 Feb 10	open 10	* 10	* 10	open 10	23 Feb 10	* 11	# 10	2 Mar 11
Oslo	59°55'	010°45	2 Jan 11	# 10	* 11	14 Feb 10	open 10	* 10	* 10	open 10	24 Mar 10	* 11	# 10	6 Apr 11

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS POLAND

NAME	LOCATION Latitude N	Longitude E	FIRST ICE Earliest	Average	Latest	END OF SHIPPING + Earliest	Average	Latest	START OF SHIPPING Earliest	Average	Latest	LAST ICE Earliest	Average	Latest
Danzig	54°21	018°40	16 Nov 47	5 Jan 37	* 47	4 Feb 11	open 10	* 11	* 11	open 10	3 Mar 11	* 47	3 Mar 37	2 Apr 47
Rugenwalde Bad [illegible]	54°25	016°25	22 Nov 20	6 Jan 20	* 20	20 Feb 20	open 20	* 20	* 20	open 20	21 Feb 20	* 20	25 Feb 20	18 Apr 20

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS SWEDEN

NAME	LOCATION Latitude N	Longitude E	FIRST ICE Earliest	Average	Latest	END OF SHIPPING + Earliest	Average	Latest	END OF ICEBREAKERS Earliest	Average	Latest	START OF ICEBREAKERS Earliest	Average	Latest	START OF SHIPPING Earliest	Average	Latest	LAST ICE Earliest	Average	Latest	MAXIMUM THICKNESS in (1 in = 2.54 cm) Mean	Absolute
Goteborg	57°43	011°58	25 Nov 11	18 Jan 10	* 11	16 Jan 10	open 10	* 10	na	na	na	na	na	na	* 10	open 10	18 Feb 10	* 11	26 Feb 10	24 Apr 11	11.0 unk	26.0 unk
Malmo	55°36	013°00	na	Early Jan	*	na	na	*	na	na	na	na	na	na	*	na	na	*	Late Feb	Mid Apr	9.0 unk	30.0 unk
Ahus	55°55	014°17	8 Jan 10	28 Jan 10	* 10	27 Jan 10	open 10	* 10	na	na	na	na	na	na	* 10	open 10	29 Mar 10	* 10	27 Feb 10	9 Apr 10	11.0 unk	30.0 unk
Visby	57°38	018°18	8 Jan 10	# 10	* 10	11 Feb 10	open 10	* 10	na	na	na	na	na	na	* 10	open 10	5 Apr 10	* 10	# 10	24 Apr 10	7.0 unk	20.0 unk
Stockholm	59°20	018°03	30 Nov 17	na	18 Feb 17	na	na	na	na	na	na	na	na	na	na	na	na	21 Jan 17	na	24 Apr 17	12.1 25	18.[illegible] 25
Svenska Hogarna	59°26	019°30	9 Jan 10	15 Feb 10	* 10	2 Feb 10	open 10	* 10	na	na	na	na	na	na	* 10	open 10	3 May 10	* 10	1 Apr 10	3 May 10	15.0 unk	30.0 unk
Gavle	60°40	017°10	22 Nov 41	24 Dec 41	23 Jan 41	24 Jan 41	open 41	* 41	28 Jan 11	open 11	* 11	* 11	open 11	2 May 11	* 41	open 41	6 May 41	5 Mar 41	14 Apr 41	13 May 41	17.2 25	35.0 26
Hudiksvallsfjarden	61°42	017°13	15 Nov 41	12 Dec 41	1 Feb 41	7 Jan 41	31 Jan 41	* 41	1 Feb 11	open 11	* 11	* 11	open 11	2 May 11	* 41	8 Apr 41	7 May 41	7 Apr 40	27 Apr 40	20 May 40	18.0 25	31.3 26
Harnon	62°36	018°00	16 Dec 41	29 Jan 41	* 41	27 Dec 41	14 Feb 41	* 41	25 Jan 11	open 11	* 11	* 11	open 11	2 May 11	* 41	18 Apr 41	19 May 41	* 41	17 Apr 41	2 Jun 41	na	na
Umea	63°50	020°15	13 Nov 30	3 Dec 30	11 Jan 30	22 Dec 30	20 Jan 30	* 30	na	na	na	na	na	na	* 30	21 Apr 30	22 May 30	25 Feb 30	29 Apr 30	24 May 30	26.0 unk	47.0 unk
Lulefjarden	63°35	022°00	23 Oct 37	11 Nov 37	19 Dec 37	30 Nov 41	25 Dec 41	1 Feb 41	22 Dec 8	8 Jan 8	* 8	* 8	5 May 8	21 May 8	16 Mar 41	7 May 41	22 May 11	4 May 41	16 May 41	27 May 41	na	na
Karlsborg	65°48	023°17	29 Oct 39	19 Nov 39	21 Dec 39	24 Nov 41	18 Dec 41	16 Jan 41	21 Dec 11	17 Jan 11	25 Feb 11	25 Apr 11	18 May 11	25 May 11	3 May 41	15 May 41	30 May 41	6 May 40	20 May 40	4 Jun 40	28.0 25	47.0 26

NOTES:

(10) Number refers to years of definite data used in computing the date given. Exact dates, e.g. 5 Jan, are more accurate than indefinite dates, e.g. Late Jan. When dates are shown as indefinite, the years of record were either indeterminable or of less than five years duration.

\# Occurrence of no ice during a season for years of record is greater than 50%

* In at least one year of record no ice or closing of navigation occurred during a season

na Data not available

\+ Shipping season may be extended by use of icebreakers or reinforced ships

open Navigation not normally interrupted by ice

(unk) Number of years unknown

FIG. 29 FREEZEUP AND BREAKUP DATES (Cont'd)

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS U.S.S.R.

NAME	LOCATION Latitude N	LOCATION Longitude E	FIRST ICE Earliest	FIRST ICE Average	FIRST ICE Latest	END OF SHIPPING * Earliest	END OF SHIPPING * Average	END OF SHIPPING * Latest	START OF SHIPPING Earliest	START OF SHIPPING Average	START OF SHIPPING Latest	LAST ICE Earliest	LAST ICE Average	LAST ICE Latest
Vyborg	60°42	028°45	23 Oct 19	25 Nov 19	7 Jan 19	2 Dec 28	18 Jan 28	28 Feb 28	3 Mar 28	23 Apr 28	11 May 27	21 Mar 29	29 Apr 26	15 May 29
Leningrad	59°55	030°15	8 Nov 6	29 Nov 21	11 Dec 6	18 Dec 20	14 Jan 20	15 Feb 20	18 Mar 21	16 Apr 21	1 May 11	6 Apr 11	2 May 21	8 May 11
Tallinn	59°25	024°45	21 Dec 28	22 Jan 28	* 28	11 Jan 28	7 Feb 28	* 28	* 28	24 Mar 28	17 Apr 28	* 28	8 Apr 28	14 May 28
Sormsi	59°00	023°13	25 Oct 42	12 Dec 42	2 Feb 42	27 Nov 42	6 Jan 42	15 Feb 42	18 Feb 42	1 Apr 42	29 Apr 42	20 Mar 42	22 Apr 42	26 May 42
Parnu	58°24	024°32	6 Nov 35	1 Dec 35	1 Feb 35	24 Nov 35	18 Dec 35	12 Jan 35	16 Mar 35	10 Apr 35	27 Apr 35	21 Mar 35	22 Apr 35	20 May 35
Riga	56°57	024°06	16 Nov 41	13 Jan 41	* 41	18 Dec 41	4 Feb 41	* 41	* 41	13 Mar 41	16 Apr 41	* 41	8 Apr 41	15 May 41
Ventspils	57°24	021°31	16 Nov 28	8 Jan 28	* 28	22 Jan 10	11 Feb 10	* 10	* 10	16 Mar 10	4 Apr 10	* 28	8 Apr 28	16 Apr 11
Klaipeda	55°43	021°07	14 Nov 39	17 Dec 39	15 Mar 39	3 Jan 10	26 Jan 10	* 10	* 10	20 Mar 10	16 Apr 10	31 Jan 39	23 Mar 39	21 Apr 39
Kaliningrad	54°43	020°30	3 Nov 30	3 Dec 30	11 Jan 30	na	na	na	na	na	na	26 Feb 30	27 Mar 30	19 Apr 30

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS DENMARK

NAME	LOCATION Latitude N	LOCATION Longitude E	FIRST ICE Earliest	FIRST ICE Average	FIRST ICE Latest	LAST ICE Earliest	LAST ICE Average	LAST ICE Latest	MAXIMUM THICKNESS in 1 in = 2.54 cm Absolute
Fredericia	55°35	009°46	28 Nov 45	21 Jan 45	** 45	** 45	6 Mar 45	8 Apr 45	8.0 unk
Copenhagen	55°40	012°35	18 Dec 12	3 Feb 12	** 12	** 12	7 Mar 12	3 Apr 12	na
Arhus	56°11	010°15	20 Dec 27	6 Feb 27	** 27	** 27	8 Mar 27	2 Apr 27	14.0 27
Frederikshavn	57°26	010°32	17 Dec 25	18 Jan 25	** 25	** 26	2 Feb 25	1 Apr 26	12.0 25
Esbjerg	55°28	008°27	18 Nov 45	2 Jan 45	** 45	** 45	20 Feb 45	4 Apr 45	na

NOTES

- \- Shipping season may be extended by use of icebreakers or reinforced ships
- 10 Number refers to years of definite data used in computing the date given
- na Data not available
- unk Number of years unknown
- * In at least one year of record no ice or closing of navigation occurred during a season
- ** In at least one year of record no ice occurred during a season
- *** In at least one year of record no ice or freezeup occurred during a season

ICE CONDITIONS AT SELECTED COASTAL LOCATIONS FINLAND

NAME	LOCATION Latitude N	LOCATION Longitude E	FIRST ICE Earliest	FIRST ICE Average	FIRST ICE Latest	FREEZEUP Earliest	FREEZEUP Average	FREEZEUP Latest	BREAKUP Earliest	BREAKUP Average	BREAKUP Latest	LAST ICE Earliest	LAST ICE Average	LAST ICE Latest	MAXIMUM THICKNESS in 1 in = 2.54 cm Mean	MAXIMUM THICKNESS Absolute
Kemi	65°44	024°34	7 Oct 42	6 Nov 42	29 Nov 42	19 Oct 42	12 Nov 42	19 Dec 42	6 May 36	19 May 36	1 Jun 36	6 May 42	20 May 42	2 Jun 42	28.5 50	41.4 50
Oulu	65°01	025°28	5 Oct 48	12 Nov 48	19 Dec 48	23 Oct 45	21 Nov 45	24 Jan 45	19 Apr 36	8 May 36	28 May 36	19 Apr 49	17 May 49	29 May 49	31.3 20	45.3 20
Jakobstad	63°40	022°42	25 Oct 48	21 Nov 48	2 Jan 48	29 Oct 45	11 Dec 45	18 Jan 45	15 Apr 36	3 May 36	23 May 36	15 Apr 47	3 May 47	24 May 47	23.2 26	39.4 26
Vaasa	63°06	021°36	16 Oct 39	18 Nov 39	25 Jan 39	28 Oct 37	30 Nov 37	29 Jan 37	4 Apr 28	27 Apr 28	17 May 28	4 Apr 41	24 Apr 41	22 May 41	20.2 44	30.7 44
Rauma	61°08	021°30	20 Oct 46	14 Dec 46	2 Feb 46	9 Nov 44	23 Dec 44	3 Feb 44	13 Mar 36	12 Apr 36	17 May 36	3 Apr 47	22 Apr 47	20 May 47	14.7 46	37.4 46
Turku	60°27	022°17	2 Nov 48	14 Dec 48	28 Jan 48	23 Nov 47	2 Jan 47	23 Feb 47	5 Mar 36	10 Apr 36	1 May 36	24 Mar 49	14 Apr 49	6 May 49	15.2 20	23.6 20
Mariehamn	60°18	019°56	7 Jan 35	30 Jan 35	*** 35	9 Jan 35	13 Feb 35	*** 35	*** 35	25 Mar 35	17 May 35	*** 35	5 Apr 35	24 May 35	7.4 13	16.7 13
Hanko	59°50	022°57	30 Nov 47	6 Jan 47	1 Mar 47	25 Dec 44	31 Jan 44	30 Mar 44	21 Jan 36	28 Mar 36	7 May 36	9 Feb 47	11 Apr 47	7 May 47	22.0 9	27.6 9
Helsinki	60°10	024°58	10 Nov 47	21 Dec 47	30 Jan 47	2 Dec 45	8 Jan 45	27 Feb 45	5 Feb 36	14 Apr 36	5 May 36	16 Feb 49	18 Apr 49	6 May 49	18.4 50	29.5 50
Loviisa	60°25	026°17	6 Oct 47	5 Dec 47	2 Feb 47	4 Nov 45	16 Dec 45	4 Feb 45	13 Apr 36	27 Apr 36	14 May 36	15 Apr 49	30 Apr 49	5 May 49	21.0 41	29.9 41